TO THE READER

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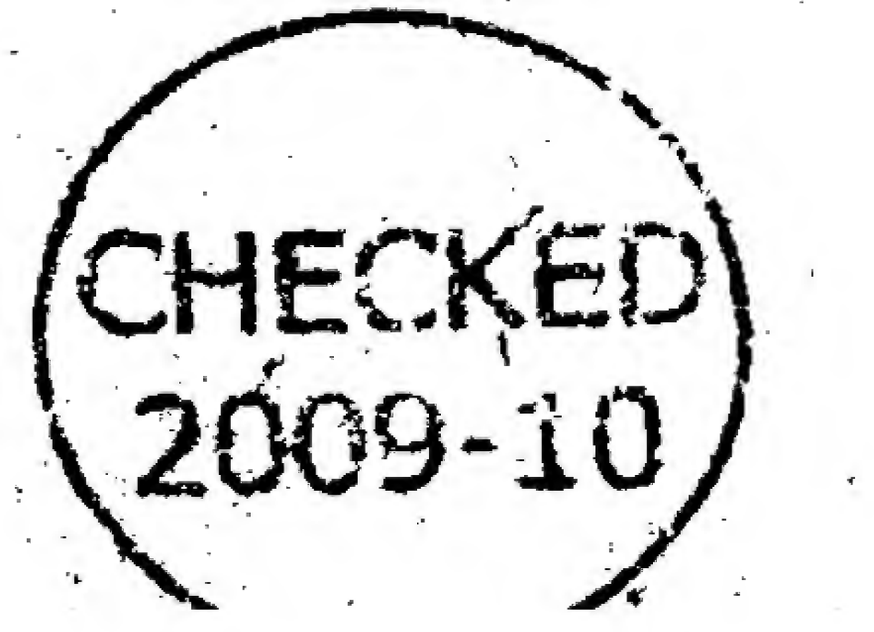
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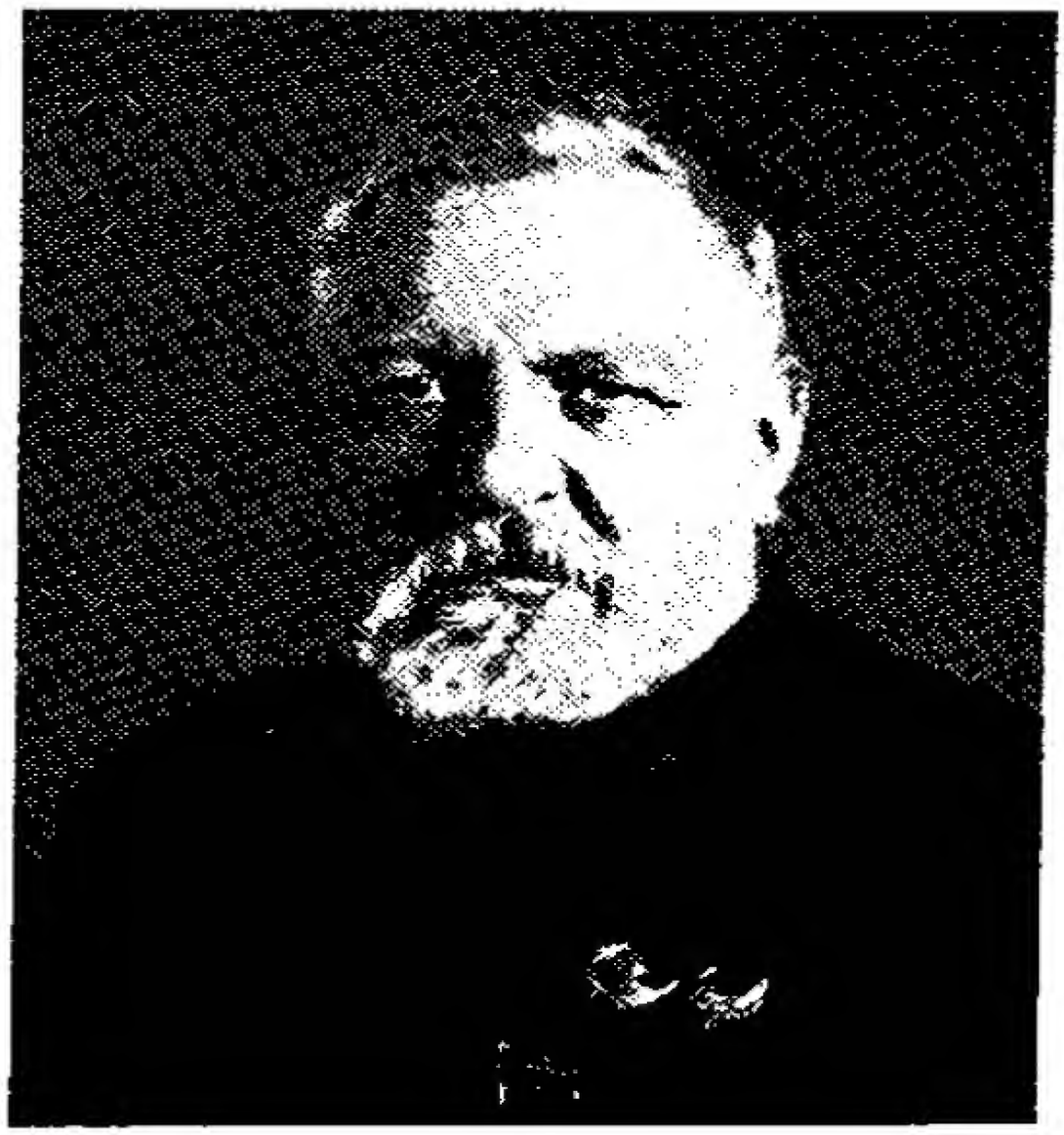
SOVIET TRANSPORT

RAIL, AIR & WATER

By Professor
V. OBRAZTSOV
and others



ACADEMICIAN VLADIMIR OBRAZTSOV (*born* 1874), *author of this booklet, has published more than* 100 *works on railway development including "Stations and Junctions," "General Courses in Railway Construction," "Fundamentals of the Railway Network," Principal Data for the Planning of Railway Stations," and "Railways in the Town." He has been twice awarded a Stalin prize and decorated with the Order of Lenin and The Order of the Red Banner of Labour.*

Obraztsov is a member of the Supreme Soviet of the U.S.S.R.

★ ILLUSTRATED SOVIET BOOKLETS ★

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RAIL, AIR AND WATER

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CONTENTS

I. SOVIET RAILWAYS

by VLADIMIR OBRAZTSOV
Member of the Academy of Sciences of the U.S.S.R.

THE FIRST RAILWAYS IN RUSSIA

THE first railway in Russia was built in 1838. It connected St. Petersburg with its suburb, Tsarskoye Selo, and had a six-foot gauge (1.829 metres). The next line, from Warsaw to Vienna was built in 1848-1851. It had a 4′ 8½″ track (1.435 metres) which is the normal gauge in Europe. The first trunk line between St. Petersburg and Moscow was modelled after certain American lines and had a five-foot gauge (1.524 metres).

This gauge became the standard for Russian railways in future construction and the track on the first two lines was subsequently changed. This difference in gauge between Russia and the Western European countries is, to this day, an obstacle to direct rail communications between the U.S.S.R. and foreign countries.

Prior to the Soviet Revolution the building of railways in Russia proceeded at an uneven pace as can be seen from the accompanying table:

Development of Railway Lines in Russia (including Finland):

Year	European Russia	Asiatic Russia	Total
	Kilometres	Kilometres	Kilometres
1840	26	—	26
1850	601	—	601
1860	1,589	—	1,589
1870	11,243	—	11,243
1880	23,857	125	23,982
1890	30,957	1,433	32,390
1900	48,107	2,869	50,976
1910	59,559	17,390*	76,949*
1914	62,200	17,390*	79,590

* The figure includes the Chinese Eastern Railway.

The railway administration in Tsarist Russia did not pursue a definite policy. Sometimes rail construction was in the hands of the State and at other periods it was given into the hands of private companies.

During the 1914-17 period the government held more than 67 per cent. of all the railway lines, the remainder belonging to eight large companies, each of which owned from 2,400 to 4,000 km. (1,500-2,500 miles) of lines (including the Chinese Eastern Railway) and to a number of small companies.

Consequences of the unsound planning of the Russian railways make themselves felt to this day. For instance, a line running across the shortest route from Moscow to Siberia via Sverdlovsk and Omsk has not been built because the policy of the Tsarist government in granting preferential treatment to the Moscow-Kazan railway prevented the building of the Gorky-Kazan-Krasnoufimsk line.

From the technical standpoint, however, the Russian railways had many achievements to their credit.

It is not always realised that the line of latitude through which runs the northern boundary of the United States (49° North) is almost the same as that at Kharkov (50° North) and that it runs far to the south of Central and Northern Russia, the Volga area, the Urals and Siberia (50°-70° North). The country's continental climate, the frosts and heavy snows demand not only special methods of construction but also special methods of exploitation.

Large railway bridges (up to 2,330 metres, i.e. 2,560 yards) had to be built across the Dnieper, Volga, Ob, Yenisei, Amur and other rivers. During the spring floods the waters of these rivers overflow in places to a width of tens of miles. All these factors naturally demanded special technical measures. Even though bridge construction was hardly developed in Russia in those days, the bridges built in the course of railway development may well be the pride of Russian engineering, as well as such developments as the Baikal Line with its 38 tunnels on 84 miles of track, and the Chinese Eastern Railway with its projects for the building of entire cities (Harbin and others). Russian architecture also takes

pride in the buildings of her largest railway stations.

By 1911 Russian railways had the following indices of operation as compared with other countries:

	European Russia	Germany	France	U.S.A.
Passenger-Kilometres* Carried per Kilometre of Line (in thousands)	448	712	535	136
Cost of carrying Passenger for one Kilometre (in kopeks)† ...	0.82	1.20	1.46	2.84
Ton-Kilometre of Freight Carried per Kilometre (in millions)	1.05	1.04	0.59	1.10
Exploitation Costs plus Depreciation & Interest on Capital per Ton-Kilometre (in kopeks)	1.09	1.64	1.70	1.04
Average Cost of One Kilometre of Track (in Roubles)	96,000	132,000	164,000	87,000

The density of the railway lines per capita was lower in Russia than in other countries. For every 10,000 inhabitants the length of railway lines was as follows:

European Russia	3.9 kilometres
Asiatic Russia	4.8 ,,
Germany	9.9 ,,
France	13.0 ,,
United States	42.8 ,,

The semi-feudal policy of the Tsarist autocracy resulted in the unpreparedness of the Russian railways for World War I. The distribution of Russia's network of railways was far inferior to the German. Russia had no lateral lines running parallel to the front, whereas in Germany the railway ran along the entire frontier from Memel to Tilsit and Beiten. All lines from the interior of Germany were con-

* 1 Kilometre is approximately $\frac{5}{8}$ of a mile. † 1 Kopek = 1/100 rouble.

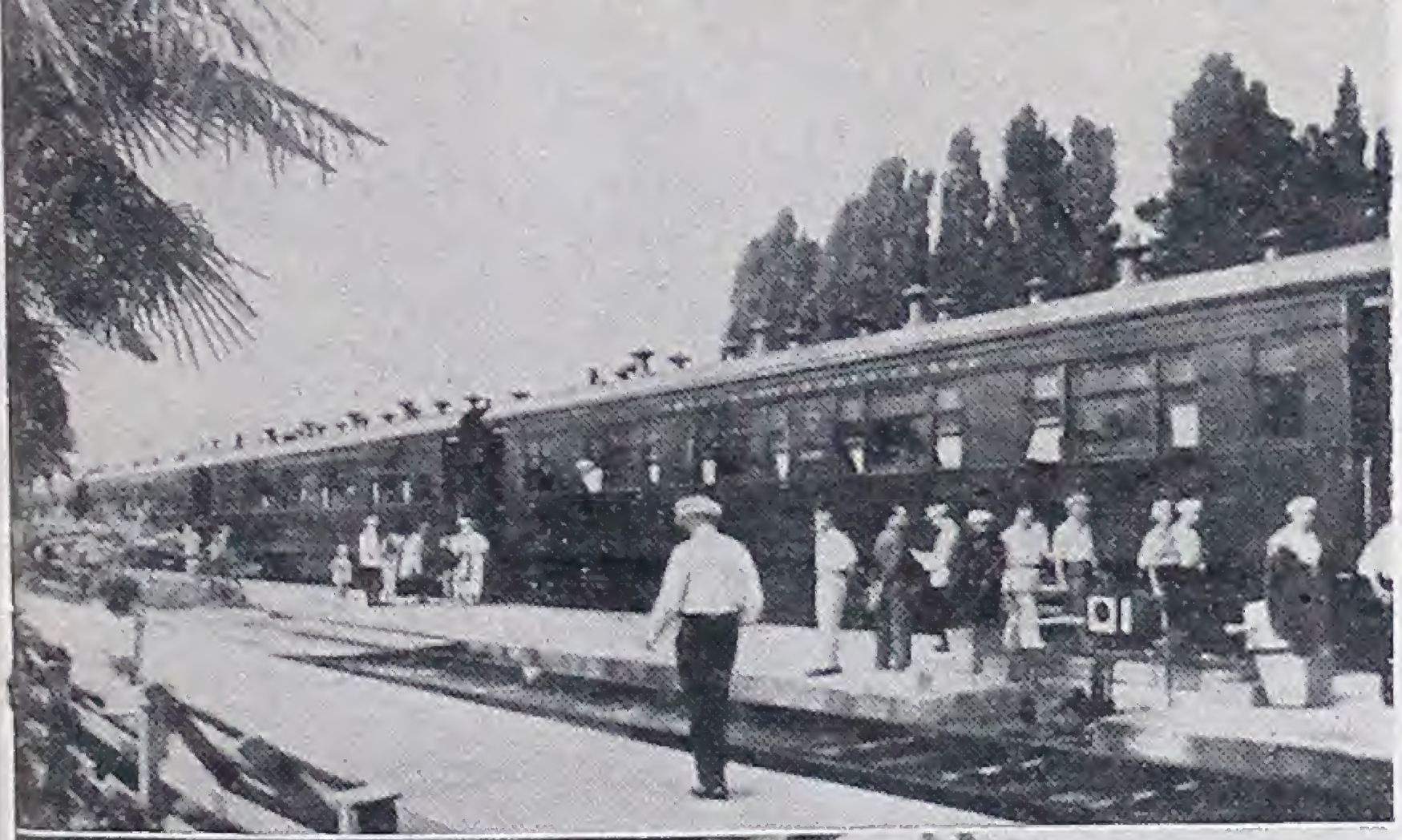
nected with this lateral line providing excellent opportunities for the concentration of troops at any point of the front. Russian railways reached the border only at five points along the entire frontier so that to shift troops from one point to another they had to be shipped back some 95-125 miles into the interior to the rail junctions of Kovno, Vilno or Warsaw.

The railways of Tsarist Russia were not suitable for offensive operations. A number of essential lines was missing. The narrow-gauge Archangelsk line had to be widened in 1915. The Murmansk line, which according to Witte, was to be constructed during the reign of Alexander III, was built only in 1916.

The 1914-17 war made urgent the co-ordination of the work of two Ministries (War and Railways) in the front and in the rear. A special Railway Board was set up at General Headquarters, but the dual authority hampered its work, as well as the private companies who obtained special conditions and privileges.

Particularly difficult was the fuel situation. With the outbreak of hostilities, Russia lost her coal imports from Baltic ports and from Dombrovo. All the coal had to be provided by the Donets Basin. With the rise in the price of coal the mine owners found it more advantageous to sell coal to other consumers than the railways. The utilising of wagons was regulated by a rule whereby there was an equal daily exchange of wagons. Private railroad companies pursued a definite policy of not living up to this provision, preferring to use the available wagons for their own shipments.

The construction of new lines during the war was conducted by private companies which did it irrationally but invariably under the guise of war necessity. At the height of the war such [illegible] Kazan-Ekaterinburg were being built. When the narrow-gauge (470 miles) Minsk-Kamen line, running to the battle zone was about to be completed orders came from General Headquarters to discontinue construction and change it to a wider gauge since this was to be "the future trunkline to Paris." There were many such contradictory orders hampering railway development.



Sochi station on the Black Sea coast. A comfortable passenger train which runs between the spas of Sochi and Kislovodsk.

Passengers leaving the platform of the Leningrad station in Moscow after the arrival of the Red Arrow express from Leningrad.

The dining room of the Leningrad station in Moscow.

In the course of the war, transport, far from being better organised, was falling into a state of chaos. The approaching breakdown weakened Tsarist Russia.

Only the Soviet revolution has solved radically all the problems of Russian railway transport.

THE RAILWAYS IN SOVIET TIMES

THE Soviet state received a poor legacy from the Tsarist regime as far as the railways were concerned. The secession of a number of border countries in the West and the transfer of the Chinese Eastern Railway in the East cut down the railway network to 36,560 miles. During the Civil War as many as 4,000 railway bridges, 5,000 railway buildings and 400 water towers were destroyed. The situation on the railways at the time was critical in the extreme.

The Soviet Government took all possible measures to keep the railways functioning. In this they were aided by the railwaymen themselves who voluntarily joined the Red Army by the thousands. They converted ordinary wagons, coaches and locomotives into armoured trains, defended stations and bridges and, under enemy fire, restored the destroyed lines and railway structures.

During the four years of Civil War (1917-21) the railways carried 50,000 troop trains for distances of from 470-940 miles.

The years 1921-22 were the hardest for railway transport, with loadings dropping to about one-third of the 1913 level.

A number of measures undertaken by Lenin and Stalin for the improvement of railway transport brought about swift restoration, with the result that in five years, by 1926-27, all indices of railway operation exceeded the 1913 level, as shown in the following table:

Year	Daily Loadings (in thousands of wagons). In 1920 U.S.S.R. Borders	Freight Carried (in thousands of millions of ton-kilometres)	Passenger Service (in thousands of millions of passenger-kilometres)
1913	27	65.7	25.2
1921-1922*	9.6	16.1	—
1922-1923	11.7	23.5	13.9

* The budget year ran from October to September.

1923-1924	13.5	33.7	15.4
1924-1925	17.4	24.4	19.0
1925-1926	24.0	68.9	23.4

This swift restoration of railway transport was all the more remarkable since the country in those days was in an extremely grave economic situation and was almost completely isolated from the rest of the world.

The year 1928 ushered in the First Five-Year Plan. The need to develop heavy industry first and foremost did not allow the country to appropriate large sums for railway development. The problem of reconstruction of the railways was raised in its entirety in the year 1931. This sweeping plan provided for the electrification of the railways, the introduction of powerful locomotives, large freight cars, automatic coupling, automatic blocking and signalling, the reconstruction of the track and the mechanisation of loading and unloading operations. At the same time study of the maximum occupation of the line, was begun.

The comprehensive programme of railway reconstruction was guided by L. M. Kaganovich, People's Commissar of the Railways. An energetic statesman, he put an end to the "theory of limits" on the railways. The exponents of this theory held that the low standards of work were the "limit" and that they could not be improved upon "until the complete reconstruction of the railways."

The call Kaganovich issued to the best railwaymen resulted in a great improvement in the organisation of service and in the fuller utilisation of the railway's great potentialities.

From February, 1935, to June, 1935, wagon loadings rose from 55,000 to 70,000 daily, i.e., by 28 per cent.

On July 30th, 1935, Soviet railwaymen were received in the Kremlin by J. V. Stalin and reported to him on their achievements. On August 5th, the Soviet Government decorated many of the railwaymen who won distinction by their work.

The movement for high labour productivity, known as the Stakhanovite movement, originated in the Donets coalfields and was swiftly taken up on the railways.

Locomotive engineers and yard masters presented schemes for the most rational usage of available reserves. By increasing pressure in the boilers, locomotive engineers managed to carry heavier freight trains at greater speeds. The weight of trains was brought up to 4,500 tons and speeds increased to 60-65 kilometres per hour (i.e., 37-40 m.p.h.). New methods were introduced in marshalling trains, particularly the simultaneous sorting and marshalling. This brought about a reduction in the idle time of wagons.

The main figures showing the work of the Soviet railways from 1926 to 1937 are as follows:

						U.S.A.	Germany
	1913	1925-26	1929	1935	1937	1937	
Length of Railways in Thousands of Kilometres ...	58.5	74.4	77	83.8	85	402	59
Freight Shipments in Millions of Tons	132.4	83.5	188	388.5	517	1,928	449
Freight Turnover in Thousands of Millions of Ton-Kilometres ...	65.7	68.9	133	258	355	577	72
Passengers Carried in millions ...	184.8	154.4	365	919	1,143	497	1,808
Passenger Turnover in thousands of millions of passenger Kilometres	25.2	23.4	32	68	91	40	50
Thousands of Ton-Kilometres per Kilometre ...	1,120	926	1,467	3,007	4,179	1,435	1,330
Gross Weight of Freight Train in Tons			854	1,035	1,190	1,726	677
Speed of Freight Trains. Kilometres per Hour ...			13.0	15.6	19.6	25.9	23

This constant and uninterrupted progress of railway transport, particularly during the years of the first two Five-Year Plan periods, continued until 1941. By that time Soviet railways carried 2.6 times more freight per kilometre of line than the United States and 2.9 times more than the German lines. The passenger service was 1.8 times greater than in Germany and 2.3 times that of the United States.

For all other indices the Soviet Union was coming close to the level of the United States and exceeded Germany in the main.

This striking progress was due in the first place to the thorough-going reconstruction carried out during those years.

What were these reconstructive measures?

BUILDING OF NEW LINES

BEFORE commencing new construction, the Soviet Union completed the building of lines begun during World War I which are of great strategic and economic significance—the Murmansk Line, the Kazan-Sverdlovsk Line and others. The new construction included the laying of secondary track on the Great Trans-Siberian Railway, up to Vladivostok; lateral lines along the Western Dvina, and the Dnieper, and the laying of secondary tracks on the lines running near the Western borders, all of which are important for the country's defence.

The development of heavy industry made urgent the building of new lines in the Urals. The building of the Kuzbas-Magnitogorsk Railway made possible the carrying of coal from the Kuzbas to the Urals and the return of Urals' iron ore to the Kuzbas. Freight costs were thereby much reduced and the building of iron and steel mills at both ends of the line was made practicable. This new line and the development of the iron and steel industry in the East greatly aided the swift expansion of the manufacture of armaments and munitions during the war.

The Turkestan-Siberian Line, built in Soviet times, provided an outlet for Siberian grain to the cotton-growing districts of Central Asia.

INTRODUCTION OF POWERFUL LOCOMOTIVES

THE following table gives a graphic idea of the developments in powerful locomotives used both for passenger and freight traffic:

Locomotive	JS (Joseph Stalin) Passenger	SU Passenger	Superiority of JS over SU (in %%)	FD (Felix Dzerzhinsky) Freight	EM Freight	Superiority of FD over EM in %%
Type*	1-4-2	1-3-1	—	1-5-1	0-5-0	—
Size of Cylinder	670x770	575x700	—	670x770	670x770	—
Steam Pressure (in atmospheres)	15	13	15	15	14	7
Firebox Grate Area (in metres)	7.4	4.73	50	7.04	4.46	58
Steam Evaporation Surface (in square metres) ...	295.16	199	50	295.16	197	50
Superheater Heating Surface (in sq. metres)	148.4	72.6	100	148	60	143
Weight in Working Order (with fuel & water) in tons	134	86	56	133	85	53
Adhesive Weight in Tons ...	82	55	50	101	85	19
Speed (kilometres) per hour	130	110	18	85	65	30

A major achievement for Russian railway engineering is the manufacture of the locomotive with a tender condenser which is able to make a 1,000-km. run (i.e., 625 miles) without taking on water. This locomotive is highly useful in arid areas of the Soviet Union (Central Asia, Southern Volga area) and also for districts with poor water.

For the first time Soviet plants produced powerful electric locomotives with an adhesive weight of 105-160 tons and a traction power of 15,000-22,000 kilograms. These electric locomotives can be used as mobile power stations.

Electric locomotives of smaller power are used for internal transport needs.

** In the so-called axle formula for locomotives used in the U.S.S.R. the first figure denotes the number of pony axles, the second figure is for the driving axles and the third figure denotes the number of rear axles. In England and the United States the same formula gives the number of wheels, and the figures have to be doubled. The Russian formula 1-5-1 is equivalent to the English 2-10-2.*

RECONSTRUCTION OF ROLLING STOCK

BEFORE the Revolution, most of the freight was carried in two-axle wagons with a small carrying capacity of from ten to sixteen tons. These wagons had hand-brakes, and their screw coupling allowed for a traction power not greater than 16,000 kg. This hampered the full utilisation of the traction power of the latest locomotives and the increase in speed. Hand-brakes made service less safe, while the small capacity of the cars necessitated longer sidings.

Such shortcomings prompted reconstruction of the rolling stock. Instead of the old two-axle "matchboxes," as these wagons were called by the railwaymen, new large box wagons were built. These new four-axle wagons were of the following types:

	Carrying Capacity in tons	Weight of Wagon	Length of Wagon with Buffers (in metres)
Closed Wagon ...	50	21.6	14.3
Hopper	60	9.53	10.0
Open Platform ...	45.4	18.4	13.39
Dumpcar	40	27.5	10.19
Tankcar	48	24.7	12.10
Gondola	60	19.5	—

A train consisting of 50 large wagons can carry some 2,500-3,000 tons of freight and is about 720 metres (790 yds.) long, whereas a train almost twice as long would have been needed to carry a similar quantity of freight in the old wagons.

Next came the introduction of automatic braking. Under this system braking is done directly from the locomotive.

The introduction of automatic brakes meant a reduction in the number of brakemen, did away with the uneven braking unavoidable under hand braking and accelerated the process, making for greater speed and safety.

Automatic coupling, with the central buffer along the lines as adopted in the United States, was also introduced. This had been debated even before World War I, but the Russian design was worked out only in Soviet times. Approximately half of the locomotives (in terms of total capacity)

have now been switched over to automatic coupling. This enables the railwaymen to increase the weight of trains and use to the full the traction power of the F and FD locomotives — which explains the sharp rise in the average weight of trains (up to 1,300 tons in 1937).

These three measures brought about a sharp improvement in the steady use of rolling stock, made for greater speed and safety and increased the weight of trains. Self-unloading cars (dumpcars, hoppers and gondolas) accelerated loading and unloading operations.

In 1920 the Soviet Government approved Lenin's plan for the electrification of the country (known as GOELRO), and in 1924 work on the electrification of the railways was launched.

By 1937 some 1,125 miles of line were electrified. Such electrified lines operate on direct current of 1,500 or 3,000 volts.

Soviet railways have the following three series of electric locomotives of 3,000 volts with 1,500 volt motors:

	Axle Formula	Capacity in H.P.	Weight in Tons	Number of Motors	Length in mm.
VL (Vladimir Lenin)	0-3-0 +0-3-0	2,770	126	6	16,220
SS (Supreme Soviet)	0-3-0 +0-3-0	2,770	132	6	16,480
PB (Political Bureau)	2-3-2	2,770	—	3	16,580

In suburban passenger trains motors of 1,500 volts and 750 volts are used.

The capacity of the coaches is as follows:

	Coach	Trailing Coach
Seats	105	108
Standing Room ...	52	52

Speaking about electrified railways, mention must be made of the Moscow underground, the first section of which was opened in 1935. As is known the Moscow subway is the finest in the world for its architecture. Construction work on the subway was kept up throughout the war years.

Great attention was devoted also to a reconstruction of the railway track. Heavier rails were laid, the number of ties increased, the road bed improved in many places. All this development facilitated greater speeds.

The use of machinery in railway construction increased considerably. Graders, ballasting and track-laying machines were introduced. Special track machinery stations were set up. Such measures made for more efficient maintenance of the line and cut down the necessary labour. In all these improvements extensive use was made of the railroad experience of the United States.

Greater traffic brought about a reconstruction in the railway stations. Their water supply was improved. More attention was paid to servicing the locomotives. Special coal bunkers were built and special appliances for removing ashes and slag from locomotive fireboxes were installed.

The need for swift handling of trains necessitated the building of large mechanised classification yards set up on American lines. The problem of train marshalling is of the utmost importance for the Soviet railways since 80 per cent. of all freights have to be hauled for long distances.

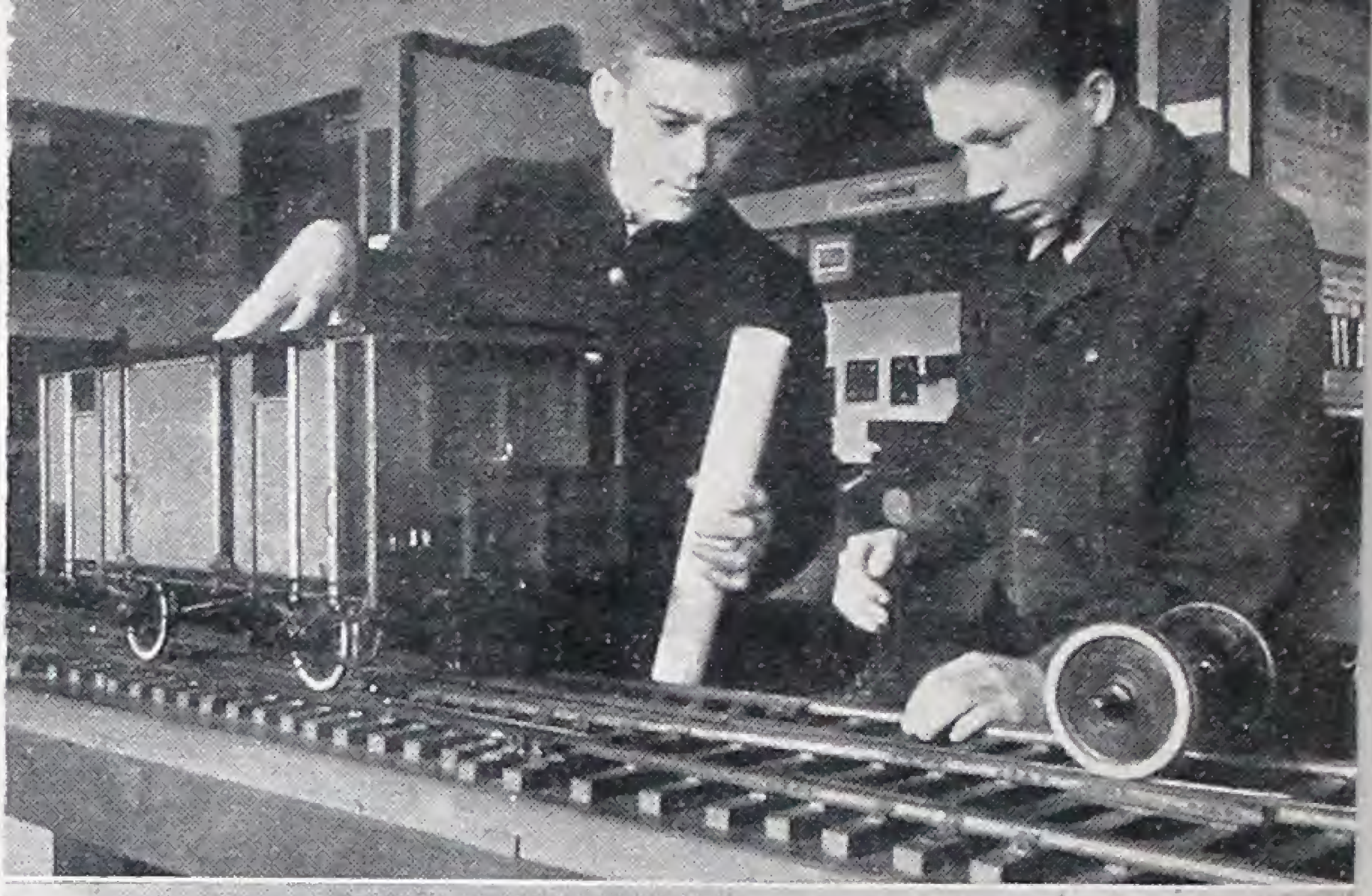
The best classification yards are built on the so-called two-way system, with a consecutive location of receiving, classification and dispatching tracks.

The mechanical equipment of retarders is also based on American experience. By 1940 more than 300 of such retarders were installed at more than 30 stations. The length of some of these stations reaches from two and a half to three miles. Such stations as Lublino near Moscow, Inskaya in Novosibirsk and Liman in the Donbas area daily handle more than 4,000 wagons, and are fitted with special lighting and signals. At many stations a central electric control of switches and signals has been installed.

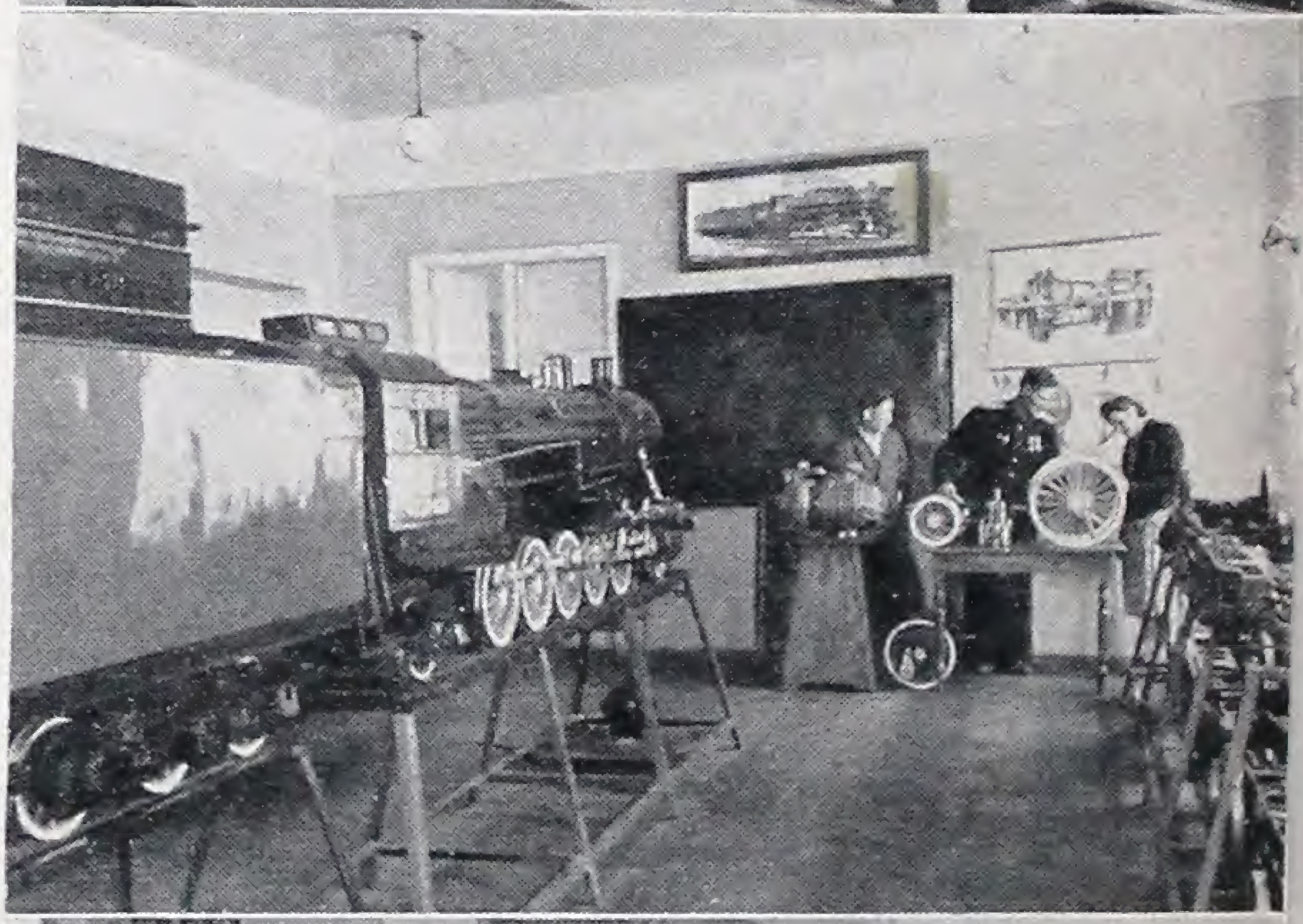
Great improvement in blocking and in automatic equipment has increased the carrying capacity of the lines.

Soviet science has done much work on problems of the organisation of service, increasing the carrying capacity of the lines, the planning of shipments, the working out of traffic routes, and accelerating the turn-round of cars, while a number of new plans for train traffic have been worked out.

The centralised planning, which is a feature of the Soviet system, is of tremendous importance to the effective, rational working of the railway administration. The pro-



Young students of the Moscow Railway Engineering Institute try out their problem on a working model.



Some 1,000 railway workers come annually to attend Central Technical Courses in Moscow. They return to take jobs in the higher grades. Here is Lieut.-Col. Kononov, director of traction, with two locomotive engineers up for a course.

Students taking Technical courses in civil engineering have access to hundreds of models in the building materials and civil engineering room.

duction, consumption and distribution of all types of industrial and agricultural commodities by separate regions and even individual enterprises is planned. It is therefore possible for the centralised railway administration to ascertain in advance the quantities of freight and their direction and to draft a plan for the distribution of the rolling stock and so on. At the same time the railways also exercise their influence on the organisation of production, preventing duplication of shipments, cutting down long-distance hauls and on similar matters.

These advantages of centralised and unified management of the railways were utilised in wartime in the United States and Great Britain where special boards assumed direction of the railways.

Among Soviet railwaymen there are many first-class inventors and rationalisers. Some of their proposals have brought about radical changes in work methods and, though their authors are not University engineers or scientists, their contributions have served to advance engineering and science. Many of their inventions and novel methods have been incorporated in textbooks and service manuals.

Higher railway educational establishments have set up special departments where experts in traffic and passenger service and in business management of the railways are being trained. Highly qualified railway executives, from dispatchers and chiefs of large stations to chiefs of railway lines and deputies to the Ministry have passed through these departments.

The training of highly-skilled personnel capable of mastering and applying the latest developments on the railways was and remains an important problem. There are many courses for raising the skill of railwaymen, special preparatory schools where railwaymen receive an education necessary to enter a higher educational establishment.

The All-Union Engineering Society of Railwaymen has branches at every railway line. Considerable activity is conducted by the Central Scientific Institute of Railway Transport which has more than 1,000 scientific workers on its staff.

Academician I. Alexandrov, the man who directed the

building of the Dnieper Hydro-electric Station, set up a commission in 1933 for the reconstruction of the railways. In 1939 this commission was transformed into a section to study scientific problems of railway transport. Three members and four corresponding members of the Academy of Sciences of the U.S.S.R. are working in this section today, and their scientific activity has proved invaluable to the progress of railway transport in the U.S.S.R.

HOW THE RAILWAYS FACED THE WAR

According to Ernst Henri,* Hitler counted on two factors to help him win the war against the Soviet Union: Great Britain's neutrality and the condition of the Soviet railways. E. Henri notes that the railways were indeed for a long time the weak spot in the Socialist state, but since 1935, things had changed radically and the Soviet railways had nothing in common with the railroads the German General Staff visualized in 1934, and even 1935, as a gap through which blows might be delivered to the Soviet Union.

The war showed that in reality Hitler had miscalculated, and not only in problems of railway transport. The swift advance of enemy troops on Soviet territory in the summer of 1941 placed a tremendous load on the Soviet railways: thousands of trains carrying troops and armaments streamed to the front, while in the opposite direction, to the east, rushed thousands of trains loaded with dismantled industrial equipment, raw materials and other property, and with the population being evacuated from the zone of hostilities. The railwaymen had to dismantle and dispatch to the interior of the country vast quantities of track and railway equipment, carry wounded from the front and bring troops and arms to the army in the field.

From the very first days of the war the railways set a high intensive pace. The attempts of the enemy air force to disrupt the work of large railway junctions and stations by bombings proved of no avail, since the railwaymen learned how to cope with damage speedily. At times minor damage

* See his book, "Hitler over Russia?" (1936).

was repaired in several hours. The men stuck to their posts, working during air raids, uncoupling burning freight trains under enemy fire.

With the advance of the enemy deep into the territory of the Soviet Union the length of the available railway lines was reduced. This naturally resulted in an overloading of the other lines so a number of new lines were swiftly built.

The Akmolinsk-Kartaly line, completed during the first years of the war, made it possible to carry coal from the Karaganda basin in Kazakhstan to the Magnitogorsk iron and steel mills in the Urals and to the central sections of Russia.

Of tremendous importance was the building of the Obozerskaya-Soroki line by which the Murmansk line, which had been cut off from Leningrad, could feed without interruption our troops in the North and carry the arms and munitions delivered from America and Great Britain. The line laid from Akhtuba Station on the Baskunchak branch line to Prichalnaya Station on the left bank of the Volga opposite Stalingrad proved a most vital artery in supplying the heroic troops defending the city. The Saratov-Kamyshino-Panshino line on the right bank of the Volga was used for bringing up supplies to the troops stationed North of Stalingrad. The new Kislyar-Astrakhan line was used for carrying Baku oil when rail communication with Rostov and Stalingrad was cut. The Kotlas-Vorkuta line provided an outlet for northern coal.

In 1942, when the Germans advanced into the Northern Caucasus and the Volga areas, large quantities of freight had to be shipped by a circuitous route. Before the rout of the Germans at Stalingrad and their expulsion from Northern Caucasus Baku oil had to be shipped across the Caspian Sea to Krasnovodsk and from there along the Central Asian railways.

At this time President Kalinin wrote: "Our railwaymen have accomplished a titanic job. They have moved for thousands of kilometres from the west to the east mountains of equipment, supplies and grain and millions of people escaping from the barbarians. The country will never forget

this service and it highly appreciates the work accomplished by railwaymen . . ."

The war, as pointed out above, introduced great changes in the economic relations between the different areas of the Soviet Union, which in turn has caused substantial changes in the direction of freight shipments. Industry in the Urals, Siberia, the Volga area and other regions of the country increased considerably.

After the temporary loss of the Donets Basin, coal for industry and the railways had to be shipped thousands of miles from the Kuznetsk and Karaganda fields. This meant an increased number of empty wagons returning in the opposite direction.

To meet the needs of the rapidly-growing metallurgical and war industries of the east internal shipments in the Urals and Siberia rose considerably. Many sections of the line, formerly of secondary importance, now became major arteries.

Priority, in wartime, had to be given to such urgent freights as army supplies, fuel, raw materials for war industry, foodstuffs and materials and equipment for the restoration of the railways. To ship these freights ahead of all regular traffic meant a tremendous re-arrangement of train schedules. Greater loads arrived at the classification yards and junctions; single cars or groups of cars had to be picked out from transit trains and, in accordance with the demands of the military authorities, sent on urgently to their destination, sometimes by forming a special train. On their arrival entire trainloads or single cars were not infrequently rerouted because of the exigencies of wartime.

A large number of classification yards and railway junctions located in the front line zone, and even at considerable distances from it, had to work in the blackout without stopping the marshalling and the dispatch of trains at night.

All these difficulties and hardships demanded intensive work on the part of the railwaymen.

THE MEN AND WOMEN WHO WORK ON THE RAILWAYS

DURING the war many railwaymen working to repair the lines near the battle fronts, had to drop their tools and take up rifles when the enemy began to make direct attacks on them.

Many individual deeds of daring have been recorded. Victor Miroshnichenko, a sergeant of the railway troops, was assigned to blow up a bridge in case the enemy drew close. A stray enemy bullet hit the lighted fuse. Miroshnichenko immediately crawled over to the explosive charge and lighted it. The bridge was blown up. Miroshnichenko gave his life to carry out his duty and block the enemy's advance.

The armoured train Bezstrashny (Fearless) fought three battles with the Germans one after the other. The crew wiped out nearly 1,000 Fascists in the course of these engagements. During one battle a flat car full of shells caught fire. Under enemy fire railwayman Dutov uncoupled the platform and with the aid of other men put out the fire.

On another occasion when a safety valve was damaged and steam pressure began to drop threatening complete stoppage of the train, assistant engine driver Babkin climbed out into the open and under enemy fire repaired the valve.

At one of the sectors of the front railwaymen were repairing a bridge when they were suddenly attacked by picked German troops. They kept the enemy at bay by well-aimed machine gun and rifle fire and then rose to the attack. In furious hand-to-hand fighting they routed the Germans, driving them back for six miles. Advancing Soviet infantry took over the new positions captured by the railwaymen and the latter returned to the bridge to finish the job.

Women play an important part in the work of the Soviet railways. They work as switchmen, couplers, porters and conductors, mechanics, train marshallers, signalmen, locomotive engineers and dispatchers. They frequently set models of a rational and resourceful attitude to their jobs. There is not a single trade on the railways not handled by women.

The number of women working on the railways is

constantly increasing. On March 8, 1942, on International Women's Day, 666 women working on the railways were given honorary titles. Among those awarded were 16 locomotive engineers, 11 assistant engineers, 65 switchmen, 28 linesmen, 25 car inspectors, 8 station masters, 5 dispatchers, train mechanics, conductors and so on. Two women engine drivers are also members of the Soviet Parliament.

Worthy of mention is the all-women crew which handled a freight train from Omsk to Moscow, a distance of 1,560 miles. This team drove the train in the winter with the mercury dropping to below −30°C. Most of the route was unfamiliar and the train had to cross the Urals range. From Omsk to Rybnoye the train carried 1,650 tons of coal and from Rybnoye to Moscow 2,300 tons of freight (94 carloads).

The women met with many hardships on the way. While on the southern Urals line they discovered that their sand sprayers were not functioning on a steep grade. Four women walked ahead of the train and for four miles poured sand on the track. On another occasion one of the engine axle boxes caught fire. With the train running at top speed Razumova, assistant engine driver, climbed on to the brake lever and in bitter weather and cutting wind kept putting out the fire.

Because of the labour shortage, railwaymen have taken on combined duties. In many cases switchmen or conductors have learned how to handle the job of train marshallers or couplers. They all join in to help unload or load urgent freights, jointly clear up snow, heat up the axle boxes of trains during cold spells and so on.

This combining of duties originated during the days of the defence of Stalingrad when, frequently, the place of a wounded train marshaller was taken by a coupler or the station master on duty was replaced by a signalman.

Such "universal" training is the best medium for stimulating the inventive genius of the workers. It is in line with the principle of polytechnical training advocated by Lenin. The study of several related occupations holds out the hope that new inventions and discoveries by Soviet railwaymen will advance railway engineering.

It is the business of the railwaymen's trade union to see that working conditions for their members improves step by step with the technical improvements advanced by the Ministry of Railways. The Ministry and the union work in friendly co-operation with one another, each accepting suggestions or criticisms made by the other for the welfare of the millions of railway workers.

One of the union's main jobs in 1946 has been to supply and equip rest-rooms and hostels for train crews at all loco. depots and at the junctions where they change shifts. At the present time there are over a thousand of these in the Soviet Union. Each has a lounge equipped with upholstered furniture: there are showers and special rooms for drying and cleaning clothes.

Under the new Five-Year Plan more rest-rooms and hostels are being built, and their amenities are being further improved. On leaving their train, our drivers, firemen and guards can be sure of a shower or a bath, with a change of clothes; of an easy chair; and then of clean pyjamas and a comfortable bed. The service staff dry and clean their clothes for them ready for when they start out again.

Special working clothes are of course issued free to Soviet railwaymen. Drivers, assistant drivers and firemen get overalls, felt boots, sheepskin coats, padded jackets and trousers. Guards get long Russian sheepskin coats.

Long distance locomotives are being equipped with special wash-basins for the engine crew, with hot and cold carbonated water.

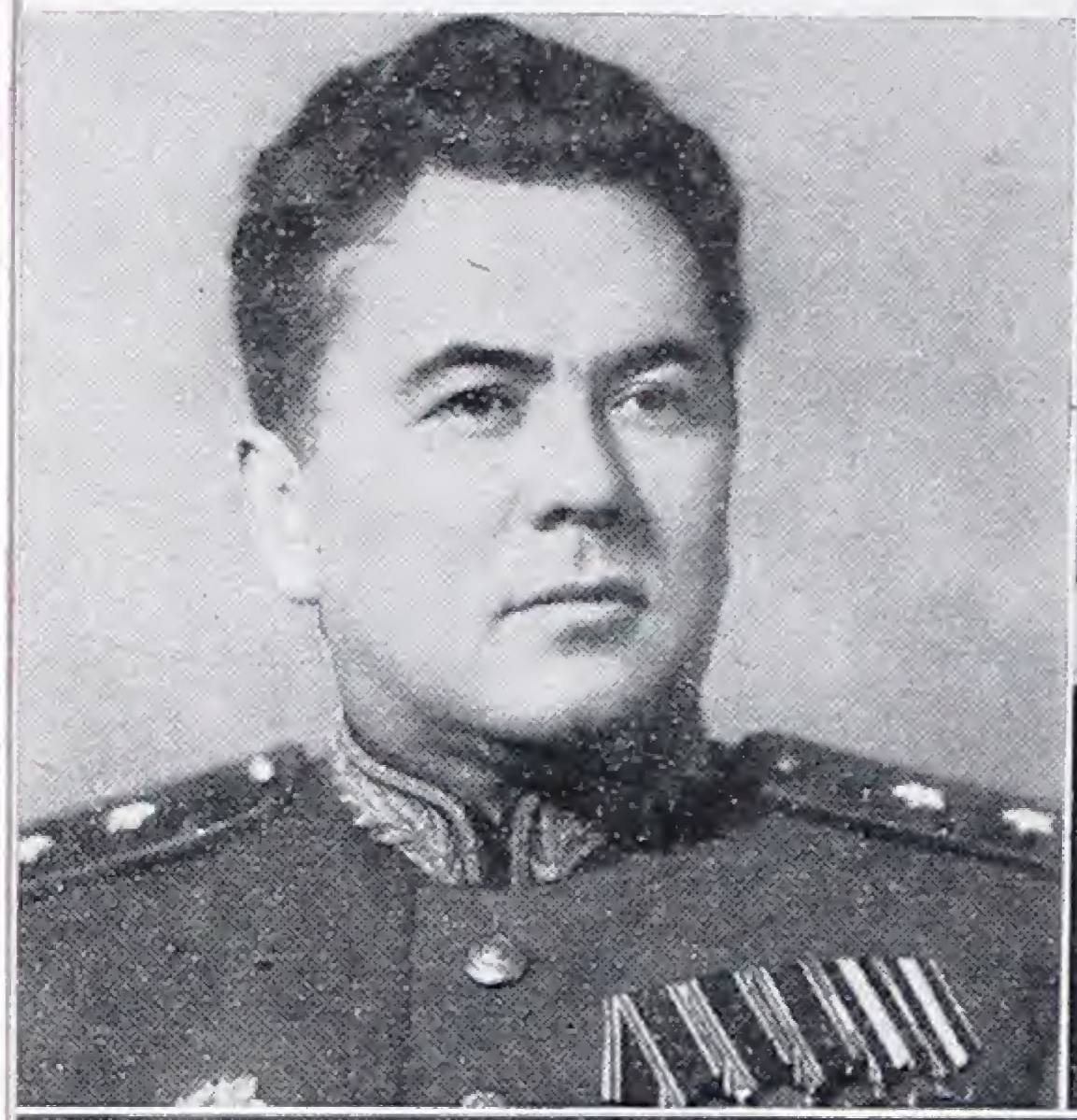
Safety on the lines is a big question. Locomotives are now being fitted with an apparatus which automatically applies the brakes at a warning signal, thus eliminating any possibility of over-running signals.

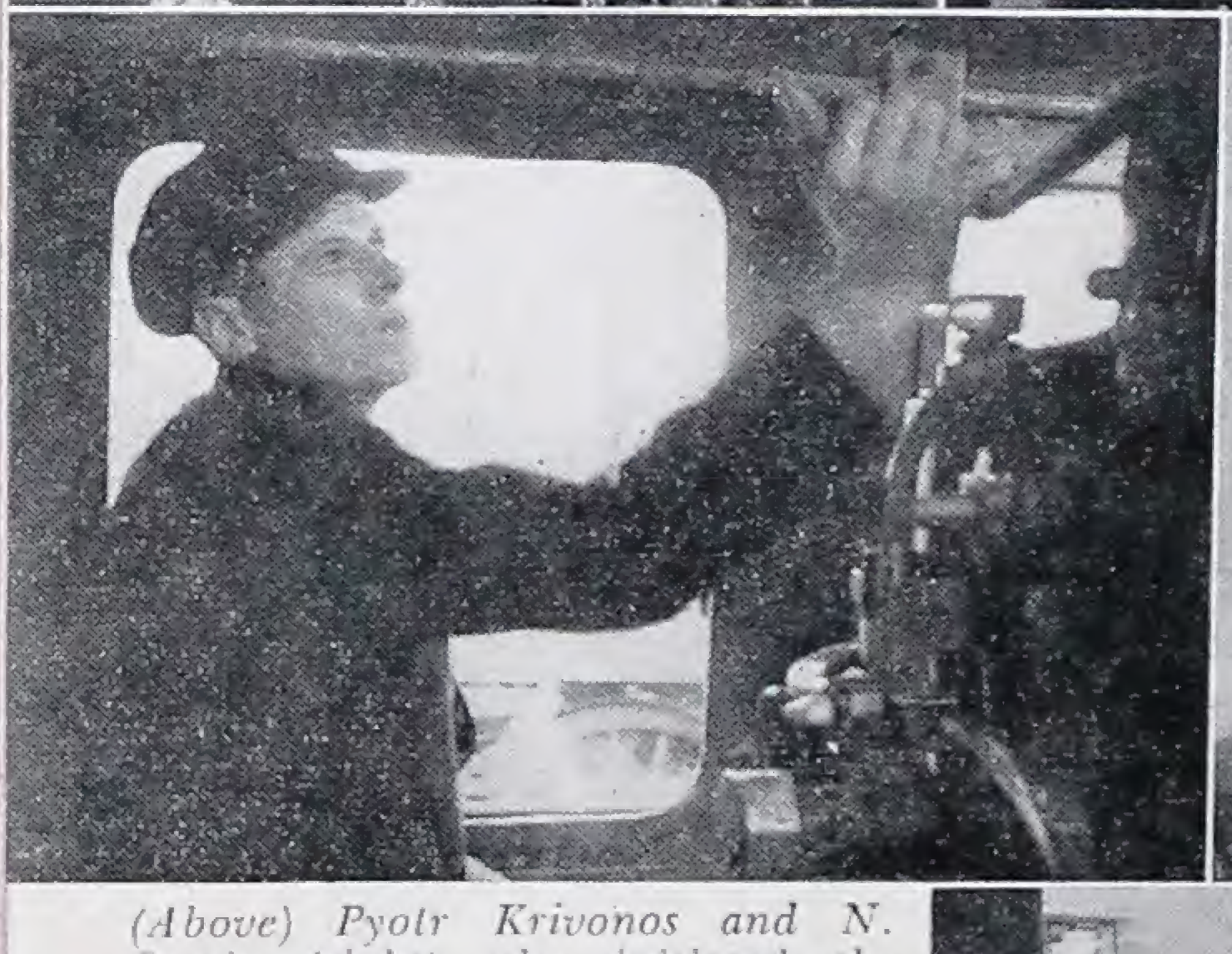
The comfort of brake-vans on goods trains is being improved, so that goods guards can be a bit more cosy when working in winter conditions. To take a heavy goods train over the Urals, for instance, in the depths of winter, is no light job.

New heating apparatus is being installed for locomotive and wagon repair shops. Heat curtains are being installed at the entrances, which will stop the penetration of cold air

(Right) Valentina Drozdova, driver of a powerful locomotive.

I. V. Kovalev, Minister of Railways.





(Above) Pyotr Krivonos and N. Lunin (right) who initiated the Stakhanov movement on the railways.

(See pp. 25-26, 31).

Porters loading luggage at a busy Moscow station.

into the buildings even while engines and cars are passing in and out. The internal heating system is calculated to compensate for the great losses of heat which occur. Ventilation is being improved too.

Attention is being given to the better lighting of stations, repair shops and railway yards. For instance, big reflectors on special stands are being installed in depots and shops, and searchlights are being fitted at stations.

The railwaymen of the central Russian lines, besides fitting out 14 new sanatoria in 1946, have also fitted up a ship on the Volga for themselves as a floating rest home. In the next five years the Soviet Ministry of Railways is to restore and to build 30 sanatoria, 340 polyclinics and dispensaries and 170 hospitals for railwaymen and their families. New kindergartens and creches will accommodate 35,000 railwaymen's children.

The Soviet railways own 7,575 auxiliary farms, which, in 1946, will have provided 156,000 tons of potatoes, 228,000 tons of vegetables, 21,800 tons of milk, 30,800 tons of meat and 11,500 tons of fish from their own ponds. No wonder that trade unionists devote particular care and attention to the management of these farms.

The railwaymen hold local meetings at which managers of dining rooms, bakeries, stores and auxiliary farms report on their work and future plans. In May, 1946, the meetings held on 18 railways were attended by half a million workers. The majority of the managers and controllers were re-elected to their positions but those who found themselves subjected to severe criticisms were not re-elected.

STAKHANOV METHODS AND TECHNICAL IMPROVEMENTS

LOCOMOTIVE engineers have contributed most to the advancement of the Soviet railways. On their skill depends the speed of trains and the expenditure of fuel and water. It was three locomotive engineers—Krivonos (now director of a railway line), Lunin and Papavin who initiated the Stakhanov movement on the railways.

During the first period of the war, as mentioned earlier,

the main task of transport was to increase to the maximum the speed of military trains. Whereas during World War I the average daily distance covered by military trains was about 400 kilometres (250 miles), a distance of 800 kilometres (500 miles), and on some sections of 1,000 kilometres (625 miles) a day, was attained during the shipment of Siberian and Urals troops for the defence of Moscow and Rostov. In other words, these trains travelled at the speed of the Trans-Siberian express.

The second task was the utmost economy in fuel.

The temporary loss of the Donets and Moscow coal-fields placed the burden of supplying coal to the entire European part of the country and to the front on the Kuznetsk and Urals fields. The problem of economy in the use of coal became of paramount importance.

The first attempts at fuel economy took the shape of the movement of the so-called "twenty-tonners," i.e., locomotive engineers who saved not less than 20 tons of fuel a month. Next came the "winterers" i.e., locomotive engineers who understook to provide during the summer enough coal for the entire winter.

A highly useful technical manual on the methods of maintenance of a locomotive and on fuel economy was produced by a Novosibirsk locomotive engineer, Lunin, who won the title of Hero of Socialist Labour and a Stalin Prize for his highly efficient methods of locomotive exploitation. This booklet, which Lunin wrote in 1941, summarises his experience in locomotive care and maintenance. (see p. 31).

In conjunction with the problem of fuel economy was that of utilising low-grade coals and locally-available fuels (straw, peat, etc.). A Tula locomotive engineer, Korobkov, worked out a method for the effective utilising of low-grade Moscow coals with a simultaneous accelerated firing of the boiler. Korobkov's proposal evoked great interest among scientists (Academician Syromyatnikov) for it introduced changes into the accepted ideas as to the maximum utilisation of boiler capacities. Korobkov's method is now widely employed by locomotive engineers.

The reduction in the railway network and the need to increase shipments brought about the introduction of so-

called "heavy trains," containing one and a half or twice the number of cars in an ordinary freight train. Heavy train-loads made for a sharp increase in the carrying capacity of the lines. Usually two locomotives are employed to pull one heavy train but in some cases one locomotive does the job. Steep grades have to be taken on the run. This, of course, is possible only if the road is clear before taking this grade. The running of heavy trains depends not only on the skill of the locomotive engineers but also on co-ordinated work of the train dispatchers, station masters and linesmen.

One interesting form of such co-ordinated work is the so-called "green street," when a heavy train is given the right of way to run without a stop past several stations. The term "green street" has been borrowed by Soviet railwaymen from the vernacular of Russian automobile drivers who speak of a "green street" when traffic lights favour them at every street intersection and they keep on driving without a stop. The use of "green streets" increases the speed of trains, results in an economy in fuel and water and in many cases cuts down the halts for water. It requires great co-ordination on the part of the different branches of the railway service.

TECHNICAL MEASURES

ONE of the difficulties the railways frequently had to face in wartime were bottlenecks caused by the uneven traffic, frequent change of route and by the large shipments that had to be handled with a smaller network of lines.

The reasons for the bottlenecks were (1) the need to muster troops and armaments for a forthcoming operation on a definite sector, without being spotted by the enemy; (2) fuel difficulties at war plants caused by lack of large stocks and the difficulties of shipment along certain lines due to raids, damage or heavy snowfall; and (3) the forced transfer of freights along circuitous routes. All this held back trains at terminals, blocked the junction sidings and, at times, caused a delay in traffic in both directions.

To eliminate these bottlenecks special measures had to

be employed. Among these were (1) bunched traffic, i.e., when a number (a bunch) of trains were shipped off in one direction; (2) double-headed or coupled trains. A double-headed train has two locomotives at its head. In a coupled train the heavy wagons with automatic coupling are placed in front and the lighter wagons without automatic coupling are placed at the end of the train. This necessitates special marshalling. A coupled train has the second locomotive in the middle which eliminates extra marshalling but makes harder the taking on of water.

Empty coupled trains are hauled by one locomotive.

In addition to the usual traffic regulations employed on the lines in the interior of the country special methods were introduced in wartime on the restored lines in the liberated areas. For example, where there was a double track, trains were dispatched along both tracks in one direction, thus facilitating the handling of urgent traffic.

This was the case in Leningrad after the breach of the enemy blockade. Because the line was still in the zone of hostilities and under enemy fire, trains were dispatched only at night and in one direction only, returning the next night in the opposite direction. Later, part of the trains travelled at night in one direction, and another train the same night, was dispatched in an opposite direction.

An original method for shipping cars across water barriers was introduced during the war. When rail communications were interrupted oil tankcars were successfully floated on Lake Ladoga and on the Caspian Sea. The tankcars were coupled as usual, their axles and wheels fastened and then they were set afloat to be pulled by steamer or tugboat. An empty tankcar weighs about seven tons while it displaces about 20 tons of water. Even when loaded with 5-6 tons of oil instead of the usual 16 tons, it still keeps afloat.

Circuit routes, i.e., when loaded trains travel in one direction and return intact with all their wagons to their original starting point, have been widely employed in wartime. This method presents several advantages. Special crews in charge of the train make for better maintenance of the wagons. Since the train does not have to be classified the

turnover of wagons is considerably accelerated. The fact that the wagons return empty is of no particular importance, since under wartime conditions there is more traffic to the West than to the East and the return of a large number of empty wagons is unavoidable.

Swifter turnover of wagons was also facilitated by repair and loading and unloading of wagons without uncoupling them. This system demands precise information and preliminary preparation. The station has to be informed what current repairs are to be made in the train about to arrive. With this information the necessary parts can be prepared in advance, a repair crew is sent out to meet the train and in the course of 20 to 40 minutes all small repairs are completed. Were the repaired wagons to be uncoupled and then coupled again, the time lost in that operation would have to be added. If we take it that an average train has fifty wagons and that two wagons were in need of repairs the saving in time would be as follows: coupling and uncoupling would take ten minutes each and the two wagons would be out of the running for a day; the loss of time would be 50 wagons x 20 minutes and two wagons x 1,440 minutes or a total of 3,880 minutes. The same repairs, even if we allow 40 minutes, involve a loss of only 2,000 minutes (50 wagons x 40 minutes). Moreover the train carries its full load and the necessary freight is delivered all intact. The same considerations speak for the advantages of loading and unloading without uncoupling the wagons.

UNIFORM TECHNOLOGICAL PROCESS

A BIG part in accelerating the processes of loading and unloading is played by the introduction of the uniform technological process, whereby the organising and co-ordinating of delivery wagons and their loading and unloading at industrial enterprises is arranged jointly between the railway administration and the enterprises concerned. Abroad, the idle time of freight wagons is of no consequence because there is usually an excess of wagons. Loaded wagons, therefore, frequently become a sort of warehouse on wheels. Before the revolution such a system was of ad-

vantage to private factories and mills so the railways, interested in attracting customers, overlooked the keeping of their wagons. Such a situation, however, is intolerable in the Soviet Union which is guided by the interests of the state as a whole.

The need for a uniform technological process was first brought up by myself at a session of the Supreme Soviet of the U.S.S.R. The introduction of this process was hastened by the war when the problem of faster turn-round of wagons and the better utilisation of rolling stock became decisive for the work of the railways.

It should be noted that in the course of the war there was in other countries, too, a drive for economy in the use of rolling stock. Foreign railway journals carried many cartoons and appeals on this point. There was, for instance a cartoon of a freight wagon complaining about its idleness and another one portraying the hands of a mill clutching at a railway wagon vainly trying to get away.

The main principle of the uniform technological process consists in co-ordinating operations between the railway line and the industrial establishments, making for maximum speed in the handling of freight wagons, as well as for the simplification of a number of operations.

The first step is the mutual exchange of advance information. Trains are brought up for loading or unloading directly to the siding of the factory or mine, in accordance with a schedule drawn up in advance. Wagons are received or handed over and inspected directly at the siding. With an improvement in the process trains can be formed without previous marshalling.

The uniform technological loading and unloading process is being studied by scientific institutions, including the Academy of Sciences. It has already produced gratifying results in speeding up the turn-round of wagons.

INVENTIONS AND SCIENTIFIC RESEARCH ON THE RAILWAYS

THE railways use so many different materials and products that all the latest developments in science and engineering are of direct importance to them.

For example, they require almost 25 per cent of all metal and fuel consumed in the country. Hence any achievements in metallurgy (stronger metals, greater resistance to rust, development of special alloys) and in power (higher coefficient of efficiency, improvements in combustion, better mixture of fuel) find wide employment on the railways.

Railway construction and water supply are connected with geology, resistance of materials and the study of local resources. All the developments of physics and electrotechnical sciences have to be drawn upon. The consumption of water on Soviet railways is almost equal to its total consumption in cities, while the length of the telephone and telegraph communications on the railways is hardly smaller than the lines under the jurisdiction of the Ministry of Posts and Telegraphs.

The railways have one feature that distinguishes them from all other branches of industry—the complexity of their problems. A locomotive is an intricate machine; its performance depends not only on the quality of the metal that goes into its making but also on the roads it has to travel, their grades, the climate, and so on. The expenditure of steam in a locomotive depends on the grades and inclines, braking and stops en route; the wear and tear of wheel treads depends of the quality of the metal as well as on the state of the rails and the extent to which they have been worn, on the railway ties, on the action of the brake shoes and on the unevenness in the rolled wheels. Rails, rolling stock, bridges and so forth are affected in similar ways. All this demands of the scientists and inventors who are working on the railways a wide knowldge of all the complexities involved in rail transport.

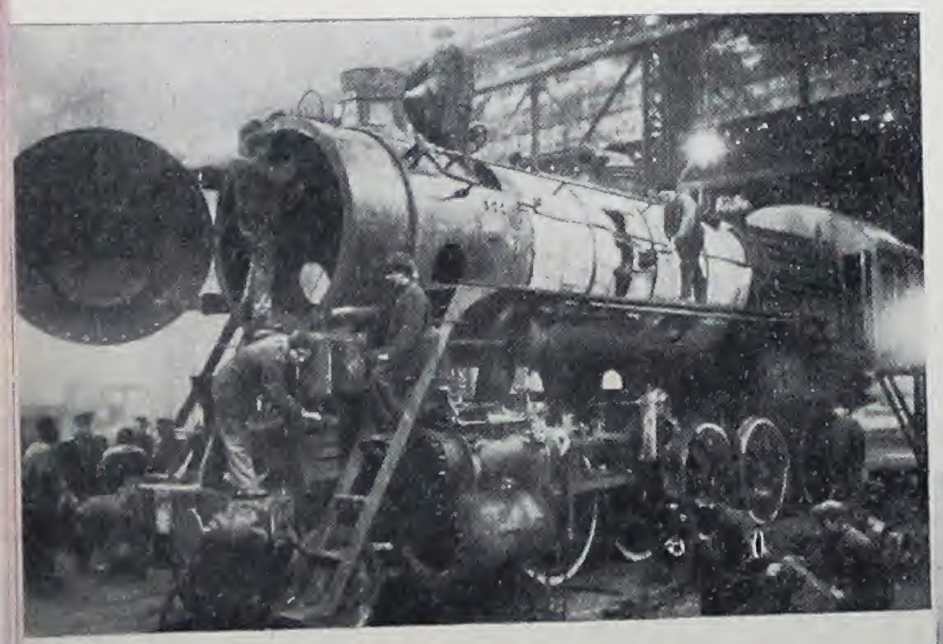
One of the biggest rationalisers on the railways is Lunin, the first locomotive engineer to receive a Stalin Prize.

In his pamphlets and in his work Lunin emphasised the need to take into account the complex conditions under which a locomotive has to operate; he explained how to utilise different types of fuel on different routes, how to use the brakes so as to reduce to the minimum the wear of the wheel

RAIL TRANSPORT

The first railway in Russia ran from St. Petersburg to the suburb of Tsarskoye Selo, in 1838.

The JOSEPH STALIN, the most powerful of passenger train locomotives. Its speed is 81 m.p.h. (see p. 12).



Assembling a POBEDA (Victory) freight locomotive at the Kolomna Locomotive Works near Moscow.

Children's railway in the suburbs of Kharkov. It is operated out of school hours by boys and girls who intend to work later on the Soviet railways.

(Below) The BLUE EXPRESS, an electric train which runs between Tbilisi (Georgia) and Borzhomi (Transcaucasia).

(Above) Oil from the south is carried across the Ukrainian plains for industry in the north.

The train has just pulled in at the Komsomolskaya Ploshad station of the Moscow Metro underground railway.

treads, how to watch for the slightest deviation in the proper work of all parts so as to prevent excessive wear or breakdown.

Invention and scientific research are closely interlinked on the railways. When the Kalinin Region fell into enemy hands the railways lost an important source of fire-proof bricks for locomotive fireboxes. A number of locally available fire clay deposits were brought to light to replace this source.

Locomotives with steam condensers used sisal fibre for filtering the steam. Sisal has to be imported and in wartime it was successfully replaced with local fibre—Lufa and Kuga. The shortage of glass for lamps was overcome by using special types of lamps with flat glass.

Special invention and rationalisation departments have been set up on the railways and conferences of inventors have been held from time to time. Important proposals made at these conferences on saving of fuel, the use of substitutes and overcoming difficulties in the water supply have been widely introduced. Higher Transport and Technical Schools and scientists, too, have helped the railways in the field of invention and rationalisation.

Some of the annual Stalin Prizes for outstanding inventions and scientific research have been awarded to railwaymen. In the last three years 17 railwaymen won awards. Among them are Academician Syromyatnikov, expert on locomotives; Peredery, eminent bridge builder; the author of this booklet, for his works on planning railway stations and junctions and on the rationalisation of their work; Vedenisov, corresponding member of the Academy and an expert on railway tracks; Doctor Sokovich, an expert on railway exploitation; Rozhnovsky, who introduced important rationalisation measures in the water supply, Lunin and others.

Considerable activity is conducted by the Central Scientific Research Institute of Railway Transport which employs more than 1,000 people. The institute has a number of sections: track, locomotive, rolling stock, signals, automatic blocking, maximum occupation of the line by passenger and freight traffic, construction, electrification

and business management. It gave invaluable service during the war.

The Academy of Sciences of the U.S.S.R. has a special section studying the scientific problems of transport. This section took part in the work of the Academy's commission for mobilising the country's productive forces for defence. It also worked out problems related to the introduction of the uniform technological loading and unloading process at war plants in the Urals and in Moscow and helped to plan an increase in the carrying capacity of the Sverdlovsk Railway Line.

RESTORATION OF THE RAILWAYS IN THE LIBERATED AREAS

THOROUGH preparatory work enabled the railwaymen to restore service swiftly in the liberated areas and keep pace with the advancing Red Army. A large number of repair trains were set up carrying special equipment and supplies. Great quantities of equipment and supplies, bridge girders and sections were manufactured and brought up close to the zone of hostilities.

Restoration work on the lines was often conducted under artillery fire. Soldier railwaymen removed mines, rebuilt the track, relaid rails at top speed to enable trains carrying arms and munitions for the advancing army to come up right to the front line.

Local railwaymen and other workers, too, helped clear the line, relay the tracks, and bring up supplies. Having lived through the horrors of the Nazi terror, the liberated men were only too eager to help.

By October, 1943, more than 10,000 miles of line had been restored, as well as 2,200 miles of secondary track and station sidings, 45 miles of wire were relaid and a large number of stations, roundhouses and other structures rebuilt.

When the Red Army crossed the Soviet border the work of the railways was rendered more difficult by the difference in the European and the Russian gauges. To relay the track meant a loss of considerable time. By using

captured locomotives and wagons the railway service was kept up on the territory taken over by the Red Army.

The last period of the war was a busy one for the Soviet railways. They had to repair the railways of Poland, Rumania, Bulgaria, Hungary, Czecho-slovakia and Germany (as far as Berlin). Soviet rolling stock had to supply the Red Army and the Soviet population and the same locomotives and wagons had to supply food for Yugoslavia, Poland and even Berlin. These heavy duties were carried out in addition to the repair of bridges, tunnels and the permanent way in the U.S.S.R. and abroad.

THE POST-WAR FIVE-YEAR PLAN AND RAILWAY TRANSPORT

IMMEDIATELY after victory the Soviet government instructed the transport authorities to prepare a five-year plan for restoring the whole system and for its further development and improved equipment. The transport systems of the Soviet Union are considered basic factors in developing industry and agriculture, leading to a further improvement in the living and cultural standards of the people.

The Law on the Five-Year Plan* for the Rehabilitation and Development of the National Economy of the U.S.S.R., adopted by the Supreme Soviet of the U.S.S.R., allots, in view of the importance of the railways, the sum of 40,100 million roubles as their share of capital investment of the country (250,300 million roubles). This huge allotment of funds is the largest ever made to the railways.

The main points provided for in the plan are: (1) the complete restoration of all the damaged railways in the country, employing all new technical devices whether constructional or related to freight and passenger traffic; (2) the carriage of the extra freights required by the growing industries and agriculture of the country during the next five years; (3) increased mechanisation and increased labour productivity on the part of railway employees, and (4) the building of new railways.

* See "Five-Year Plan for 1946-50" published by *Soviet News*, price 1/-.

According to the plan the value of industrial output in 1950 will be 205,000 million roubles (calculated in the prices of 1926-27) which is 48 per cent. more than in 1940. The farms will produce 27 per cent. more than in 1940. Obviously, from these figures a greatly improved transport service will be required, especially if we take into consideration the amount of building and restoration that will be carried on in the war-devastated towns and villages.

The rebuilding of the railways and the construction of new lines also entails a tremendous amount of work. The plan provides for the complete restoration of 9,375 miles of line in the Donets Coalfield, the Krivoy Rog Iron Field, the Moscow-Donets, Leningrad-Caucasus and other railways. The work includes the building of 1,800 large and medium bridges on the railways ruined by the Germans. Some of them are the bridges over the Dnieper, Don, Dniester, Neva, Nieman, Western Dvina, Volkhov and Bug. Some 1,500 railways stations, roundhouses and so on must be built while the 7,800 miles of line connecting them are to be built anew or repaired. We have to make good the rolling stock repair shops that have been destroyed and build 26 new plants for the building of rolling stock. Lastly we have to build living houses for railwaymen, with a total floor space of 5,500,000 square metres (59,400,000 sq. ft.).

The daily wagon loadings in 1940 amounted to 100,000. This figure will be raised to 115,000 in 1950, which is double that of 1945. The freight turnover in 1950 will be 532,000 million ton-kilometres or 28 per cent. greater than pre-war. The labour of the railwaymen must be made 15-17 per cent. more productive each year in order to carry through this programme, and this will be effected by greater use of machinery for loading and unloading and by better labour organisation.

The Five-Year Plan provides for 75 per cent. mechanisation of all railway work and an improvement of the transport departments of industrial enterprises. Greater mechanisation of the loading and unloading of river vessels will also speed up the work of the railways.

One of the most important organisational measures to be adopted to improve the country's transport is the propo-

sal to effect the turn-round of wagons in seven days in 1950 instead of the 10.9 days usual in 1945 and at the same time reducing the average run of wagons from 790 to 690 kilometres which is the same as increasing the commercial speed of the rolling stock from 6 to 8.2 kilometres an hour, an increase of 37 per cent. This is, of course, connected with a number of organisational measures and technical innovations: it will include accelerating the loading and unloading of freights, increasing the traffic capacity of lines, developing secondary tracks, the introduction of the automatic block system on 10,400 kilometres of line, the electrification of certain stretches. improved methods of making-up trains (this includes the building of 21 mechanised marshalling yards or humps.).

The permanent ways and the rolling stock will be made heavier. Over half the total length of line (50,000 kilometres or 31,250 miles) will be renewed with new, heavier type rails (50 and 65 kg/metre), the ballast will be improved so that the speed and weight of the trains may be increased. In the next five years we shall get an additional 7,585 steam locomotives, 55 electric locomotives and 865 Diesel locomotives. Other rolling stock increases will be 472,500 freight wagons (in terms of two-axle wagons) and 6,000 passenger coaches. Of the total rolling stock park 93 per cent. will be fitted with automatic brakes and 75 per cent. with automatic coupling.

Before the war Diesel locomotives were only used on the Ashkhabad railway but the war showed their great value. A Diesel-driven train is now undergoing tests on the Moscow-Kursk railway. It easily develops a speed of 62 m.p.h. and can carry enough fuel for a non-stop 500-mile run. The train consists of three coaches, of which the front and rear coaches are equipped with 310 h.p. Diesels. There are 156 seats on the train, which is provided with every passenger comfort.

During the next five years we shall build a further 5,325 kilometres of electrified line which will about double the present mileage. New lines are to be built in Kazakhstan and the Altai where a whole railway network is being built up connecting Stalinsk with Magnitogorsk and Kinel.

Before the war railway traffic in the U.S.S.R. averaged 4.2 ton-kilometres; in 1950 this figure will be raised to 4.4 ton-kilometres which is 2.5 times as much as in the U.S.A. In 1950 the railways expect to carry 2,000 million passengers which will give an average of 11 railway trips per head per year; this is a higher figure than in any other country in the world.

The new Five-Year Plan not only provides for the rehabilitation and development of the railways but also for the introduction of improved technique leading to a number of improvements; there will be greater comfort for passengers*, more beautiful stations, and improved planning of railway junctions and railway lines through the towns. The country's best architects and town-planners are taking part in this work—Academicians Shchusev, Colley, Zheltovsky and Vesnin. An architect, Ginsberg, is at present working on plans for the Crimean Coastal Railway and the scheme for linking the Black Sea coast towns by rail is to be carried out in conjunction with the completion of the Tuapse-Sukhumi-Tbilisi Railway. This new line will shorten the Moscow-Tbilisi run by 18 hours.

The Stalingrad Railway Junction will be magnificently planned and will be connected with an underground railway 30 kilometres (19 miles) long running right through the city. Underground railways are to be built in Leningrad and Kiev, and the Moscow Metro is to be extended.

Traction power on the railways is undergoing special consideration and it is intended to reduce the number of steam engines and replace them with the more efficient (three or four times more efficient) Diesel and electric locomotives. Engineers are working on the idea of building gas and gas-turbine locomotives. A big development is to take

* Already on the Moscow-Leningrad "Red Arrow" and the Moscow-Sochi express, passengers can 'phone Moscow or any city through which the trains pass. Quite a number of long-distance expresses have barbershops, shower baths, libraries and plug-in wireless sets. In the near future 60 of these luxury trains will be running on the main lines connecting Moscow with Vladivostok, Kaliningrad (Koenigsburg), Sevastopol, Archangelsk, the Donbas and Tbilisi.

place in the increased use of automatic devices and telephone communication with trains, together with centralised traffic control on large sections of the line. Radio will be increasingly used.

All the scientific forces available, from Stakhanovite workers and inventors, members of Railway Scientific and Engineering Soviets up to the staffs of the Research Institutes of the Ministry of Railways and the Academy of Sciences of the U.S.S.R. are helping in the work of improving the railways in addition to the regular railway engineers, technicians and workers.

II. AIR TRANSPORT

by LIEUT.-GENERAL ILYA SEMENOV

EARLY DEVELOPMENT

ON February 9, 1923, the Labour and Defence Council of the R.S.F.S.R. set up a government Civil Aviation Council to organise the country's air transport. The country was just recovering from the effects of the First World War and the civil war; railways, water transport, factories, power stations and mines were being restored and the farms were improving.

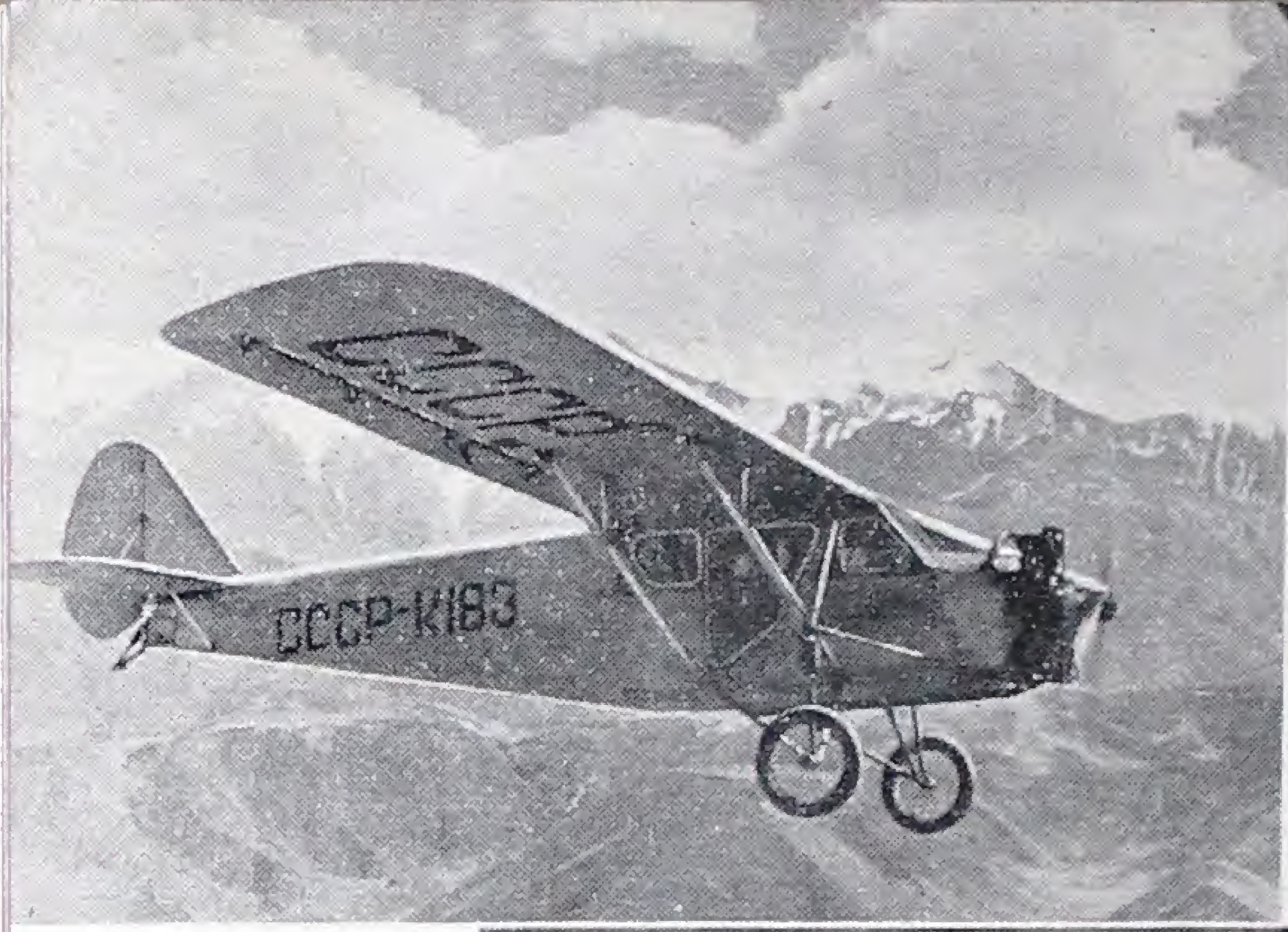
At first the civil air fleet depended on other countries to a great extent since the Soviet Union had no aircraft industry of its own and foreign aircraft plied Soviet airlines.

The greatest development came during the period of the five-year plans. At the end of the first Five-Year Plan Stalin was able to report that the country then had its own aircraft industry which was supplying transport planes in the required numbers. In the years prior to the outbreak of the Second World War, big passenger and freight planes on the main lines as well as small craft served the needs of local industries and of agriculture.

The growth of civil airlines during these prewar years may be judged by the following figures: the total length of airlines in 1923 was 420 kilometres (262 miles) and the number of passengers carried for the year was 229. In 1940 the airlines totalled 143,000 kilometres (89,375 miles), and they carried 390,000 passengers and 60,000 tons of freight and mails.

In addition to flights over the regular air lines civil pilots performed a number of other jobs connected with the national economy. Flying at low levels they sprayed fields threatened with destruction by locusts and other pests; this work requires great skill on the part of the pilot.

Then there was the fight against malaria: thousands of



An ambulance 'plane circles over a gorge in Tajikistan before landing.

Inside the cabin of a Soviet passenger 'plane.

In Turkmenistan 'planes are used to keep contact between widely scattered flocks and shepherds.

acres of swamp-land where the malaria-bearing mosquitoes breed were dusted with poisons from the air.

Many thousands of people have cause to be grateful to the Soviet Medical Air Service. The Medical Service pilots fly anywhere, over unsurveyed routes, into ice-fields or jungles and are prepared to land anywhere without a landing field. Doctors fly to the most distant parts of the country and in many cases bring dangerously ill patients back to the towns.

The airplane plays an important part in many other fields of Soviet economy. It has made wintering in the far north and navigation of the Northern Sea Route possible. Soviet aircraft protect forests and steppes from fires, they survey pastures for the herds and they guide caravans in the desert; they reconnoitre fishing grounds, carry loads of small fish for planting in new waters, carry bees and other unusual loads and sow rice from the air; they photograph the ground for cartographers and surveyors and they accompany scientific and geological expeditions.

Flying under these conditions, often where there were no surveyed routes, over mountains, ice-fields and deserts, the Civil Air Fleet trained a large number of highly-skilled pilots, navigators and mechanics.

CIVIL AIR FLEET DURING THE WAR

When Hitler Germany attacked our country the Civil Air Fleet took its place alongside the Red Army. Its members fought in the great air battles at the approaches to Moscow, they helped the defenders of Leningrad, the Crimea, the Caucasus and Stalingrad.

Transport aircraft were put to a number of varied uses on all fronts. They carried munitions to the front, evacuated wounded to the rear, delivered blood and medical supplies to front-line hospitals, reconnoitred German defences, used their transport planes as bombers to attack German trains, strongpoints and troop concentrations, they maintained communication between Soviet headquarters and units fighting behind the enemy's lines, they delivered munitions and food to beleaguered cities, delivered

munitions to the partisans, landed parties of troops and did the work of attack, reconnaissance and aim-correcting aircraft.

During the siege of Leningrad civil transport aircraft were ordered by the government to deliver 100 tons of food to the city daily. During the last two and a half months of 1941 alone, transport aircraft made over 3,000 flights across territory thickly sown with German anti-aircraft defences. They delivered 4,325 tons of food and 1,660 tons of military stores to Leningrad. On their return journeys they evacuated over 50,000 Leningraders.

Sevastopol was heroically defended for 250 days. Heavy transport aircraft flew there by night covering long distances over the sea. They crossed areas where many thousands of German A.A. guns were concentrated. During the last 10 days of the defence of the city freight-carrying aircraft made 238 flights into Sevastopol carrying food and munitions.

The story of the famous partisan column led by Kovpak (decorated twice Hero of the Soviet Union) is well worth repeating. This column made a number of daring raids on German communications and an army of 40,000 regular troops was employed to besiege its encampment. A gigantic battle was fought in the middle of the forest. The enemy was well supplied with modern weapons, heavy artillery and tanks. The partisans were lightly armed and their munitions were running low. Civil transport planes sought the partisans in the dense Bryansk Woods and brought them munitions at the most critical moment. Kovpak's partisans dealt the Germans a severe defeat and the latter withdrew leaving 10,000 dead behind them.

In the course of the war civil transport pilots made thousands of trips to the partisans and on the return journey brought back the wounded and the children of the partisans. Many of them lost their lives in this dangerous work.

Civil transport planes took part in every big Red Army operation. When Von Paulus' army was encircled at Stalingrad and General Mannstein's army had been ordered to relieve it at any cost, big Soviet armoured forces were used to intercept Mannstein. Deep snow made the delivery of supplies to the moving tanks a matter of great difficulty

and lack of the necessary fuel would have greatly reduced the manœuvrability of the tanks. Civil transport planes delivered 400 tons of fuel and munitions to the tank concentrations in a few days, always arriving as scheduled despite the bad weather conditions.

The experience that Civil Air Fleet pilots had gained in working for the medical services in peacetime stood them in good stead after the war broke out. The "medical" pilots took their tiny machines over the most difficult routes and showed great skill under war conditions. They evacuated hundreds of thousands of wounded during the war.

Soviet civil aircraft also helped other nations that were oppressed by the Fascists—they helped the Jugoslav People's Army of Liberation and the partisans of Poland, Bulgaria and Czechoslovakia.

The Germans landed paratroops to capture Marshal Tito's headquarters and a fierce fight ensued between the Jugoslavs and the Germans. Soviet Civil Air Fleet pilots were ordered to land, take Marshal Tito and his Staff and transfer them to a place of safety.

The flight took place on a dark, moonless night over mountains which reach a height of 6,500 feet. The heavy passenger planes had to be landed in the dark on ground that was little adapted for the purpose. The mission was fulfilled brilliantly and the staff of the heroic Jugoslav People's Army was saved literally under the noses of the Germans. Shornikov, Kalinkin and Yakimov were awarded the titles of Hero of the Soviet Union and People's Hero of Jugoslavia.

Similarly arduous was the everyday work of the transport pilots in the interior of the country. With the constant growth of the war industry ever larger loads of urgently required materials were delivered by air. On many occasions the timely delivery of supplies ensured the successful fulfilment of operations by the Red Army. Pilots frequently spent twenty-four hours and more at the controls in bad weather.

The difficult air route over the north eastern parts of the U.S.S.R. to Alaska was surveyed and worked during the war years. Passenger and freight planes used this route

from the U.S.S.R. to the U.S.A. and back. Its airports are specially equipped for Arctic conditions, such as landing or taking off in the Polar night, frost and blizzard, with lighthouses, radio and weather stations, while metal plates cover the runways over the permanently frozen ground.

Flying through intense cold, sometimes 60° of frost, through fogs and snowstorms, the airmen pilot their planes the 3,100 miles from Krasnoyarsk (where the trans-Siberian Railway crosses the River Yenisei) to Laurence Bay, almost at Cape Lezhnev at the U.S.S.R's. north-eastern extremity. They have to cross inhospitable territory—eleven mountain ranges (flying at 13,200 feet) and vast stretches of Siberian forest and naked tundra.

The war losses and the increased number of aircraft manufactured for the army made the training of large numbers of airmen a matter of urgent necessity. The government instructed the Civil Air Fleet to help the Red Army Air Forces with the training of army pilots. The Red Army never experienced a shortage of efficient pilots and airmen; many of the long-distance aircraft were manned by crews from the Civil Air Fleet.

During the war the Civil Air Fleet itself had several million flying hours to its credit and it had carried about two and a half million passengers and about 300,000 tons of freight. Several thousand pilots, navigators, mechanics, engineers and ground personnel were awarded orders and medals of the Soviet Union, 12 of them receiving the highest title of all, Hero of the Soviet Union.

Since the war, the Soviet air lines have shown a big development. In 1945 the Civil Air Fleet carried over twice as many passengers as in 1940.

There are, of course, many difficulties connected with the air service today. When the Germans retreated they destroyed aerodromes and blew up all the airport installations at Leningrad, Kharkov, Kiev, Rostov, Odessa, Lvov, Dniepropetrovsk and other places.

Even while the war was still in progress a certain amount of restoration work was done in the western regions of the U.S.S.R. This enabled us to re-establish air communication between the most important centres of the

Ukraine, Byelorussia and the Baltic Republics, important industrial regions and the capital, Moscow. The freight-carrying aircraft of the Civil Air Fleet are of great help in the work of restoration that is going on everywhere in the territories once occupied by the Germans.

Before the war Soviet aircraft flew on only three international air lines. Today there is regular air communication with ten European capitals; these routes are worked by Soviet aircraft. Planes belonging to the Civil Air Fleet worked for the San Francisco Conference, the Potsdam Conference and the Foreign Ministers' Conference in London.

Fast Soviet planes on the international lines are piloted by such famous airmen as Taran, Ryzhkov and Frolovsky —all Heroes of the Soviet Union—and old, experienced passenger pilots Chulkov, Polosukhin, Semenkov, Zhitelev and others.

During the first year following the war over two hundred air-lines were opened in the U.S.S.R. These are lines of All-Union importance on which passengers, freight and mail are carried. Regular air communication is maintained between Moscow and the capitals of all the Republics. Aircraft leaving Moscow arrive at their destination the same day, with the exception of those for Alma-Ata which arrive on the day following departure.

The longest air route in the U.S.S.R. is that from Moscow across the Urals, Siberia and the Far East to Khabarovsk. Fast planes cover this distance in 36 hours. New 4 engined, 60-passenger planes are being put on this service.

Within the territory of each Republic there are also dozens of shorter airlines of local importance connecting the capital of the Republic with regional and district centres.

FUTURE PROSPECTS

The prospects for development during the five years 1946-50 are closely bound up with the development of the whole national economy. The new Five-Year-Plan calls for considerable increases in the number of passengers and amount of freight and mails carried.

The rate of development of air transport during this next five years will greatly exceed that of all other forms of transport because of the speed with which freights can be delivered over long distances. The plan provides for an extension of the air route network to 175,000 kilometres (109,375 miles), that is 27.5 per cent. above the pre-war figure.

In addition to developing all airlines within each Republic and between the various republics, we shall rebuild 16 central airports, and erect 20 huge buildings or "air stations" at existing airports and newly projected fields during the next five years. Side by side with this the aerodromes on the most important air routes will be reconstructed.

In the same period new and bigger passenger aircraft are to be added to the Civil Air Fleet. Alexander Yakovlev, Andrei Tupolev, Sergei Ilyushin and others—all Heroes of Socialist Labour—are working on new designs for transport planes adapted for flying both at high and low temperatures and able to make long-distance, non-stop flights. New giant flying boats are to be used on several international air lines.

The technical re-equipment of the airlines between the Republics will ensure regular flights irrespective of weather conditions or the time of day. Large funds are being invested in the re-equipment of these lines. Moscow airport will handle over 100 planes daily and Leningrad will become one of the world's largest air terminals.

The post-war programme of the Civil Air Fleet also includes the use of large numbers of aircraft to combat insect pests in field and forest. In 1940 specially equipped aircraft were able to deal with 2,250,000 acres of forest and farmland; by 1950 there will be sufficient aircraft to handle 6,250,000 acres. In 1940 aircraft destroyed mosquito larvæ by spraying swamps over an area of 8,750,000 acres; the 1950 acreage for swamp spraying will be 12,500,000.

Gliders will be used for freight transport in the deserts of Central Asia. Helicopters designed by Ivan Batukhin will be widely used in highland, forested and swampy districts lacking airfields. Helicopters are also well adapted to

fish, whale and seal scouting, as well as for combatting crop pests.

In our country there are 30,000,000 acres of desert with constantly moving sands. These sands cause heavy losses by blocking railway lines, roads, irrigation canals and by burying crops. Before the war efforts to combat these sands were in the initial stages. Methods have now been devised of planting the seed of saksaul and other desert plants from the air so that the plant life so introduced will bind the sands and hold them in place.

Another service planned is the feeding of artificial fertilisers to standing crops from the air. This will lead to a much higher harvest yield.

Aerial-magnetic photography, topographical work, reconnoitering fish and ice, sounding the upper layers of the atmosphere and patrolling the forests, high-voltage electric power transmission lines and rafts of timber being floated down rivers—these are but a few of the tasks that will fall to the lot of the Civil Air Fleet.

Regular flights have begun for the carrying of valuable seal skins, ermine and fox furs from the Northern hunting grounds of Yakutia and Chukhotka to Yakutsk, Irkutsk and other regional centres in Siberia.

Future plans also include an improved Medical Air Service. Specially equipped air-ambulances and doctors will be on duty day and night at aerodromes awaiting emergency calls. In 1940 this service recorded about 100,000 flying hours. In 1946 the number of flying hours will be about double. If we remember that the medical service is now being worked by much faster aircraft we see that the number of human lives saved by the doctors of the Civil Air Fleet is enormous.

This, in brief, outlines the past, present and future of the Soviet Civil Air Fleet which, during the next five years, will become one of the major transport systems of this huge country.

III. THE SOVIET MERCHANT FLEET

by VICTOR G. BAKAYEV,

Deputy Minister of the Mercantile Marine

EARLY HISTORY

THE history of the Russian merchant fleet goes back many hundreds of years. At the time of Kiev Russ (1000 A.D. — 1200 A.D.) the merchants of Russia were engaged in sea trade with the East. Trade routes ran through Russian waterways from the Baltic to the Black Sea while the route to the Kingdom of Persia lay along the Volga and the Caspian.

In the Middle Ages, when the Hanseatic League flourished, Russian sea trade became passive. The mouths of the big rivers which gave access to the sea were in the hands of foreign states.

Sea trade with the west was reopened when the Englishman Chancellor sailed into the Northern Dvina where there was an anchorage at the point where Archangelsk now stands. Chancellor was seeking a north-east passage around Europe to India and China. This was the period of great geographical discovery and a special company had been formed in England to explore unknown lands. This company later became the Muscovy Trading Company.

Muscovy could not tolerate the long route from the Volga through the White Sea and the Arctic Ocean and naturally strove to regain her old seaways and re-establish her fleet. The history of the struggle for the Baltic ports is one of almost 200 years of war against Livonia, Sweden and other countries that were trying to keep Russia cut off from the sea. In wars with Turkey, the Crimea and Persia the Russian state regained the Azov, Black Sea and Caspian coastlines. In 1829 Turkey opened the Bosphorus and the Dardanelles for merchant ships and Russian foreign trade was able to reach east and west through the Mediterranean.

Russian sailors explored Okhotsk, Kamchatka and

other coastal regions of the Far East. It was not until the October Socialist Revolution, however, that Russia was able to give her merchant fleet full development.

The U.S.S.R. lies between the Arctic and Pacific Oceans. The waters of these two oceans and their seas wash the shores of the Soviet Union for a distance of over 20,000 kilometres from the Finnish frontier in the north to Korea in the Far East. The seacoast forms over 70 per cent. of the Soviet frontiers.

The seacoasts of the Soviet Union are an important factor in her economic life, in foreign trade and in the defence of the country. The sea routes are of great importance to the economy of the country. The transport of oil, timber, grain, coal and other bulky commodities is effected to a considerable extent by sea.

DEVELOPMENT UNDER THE SOVIETS

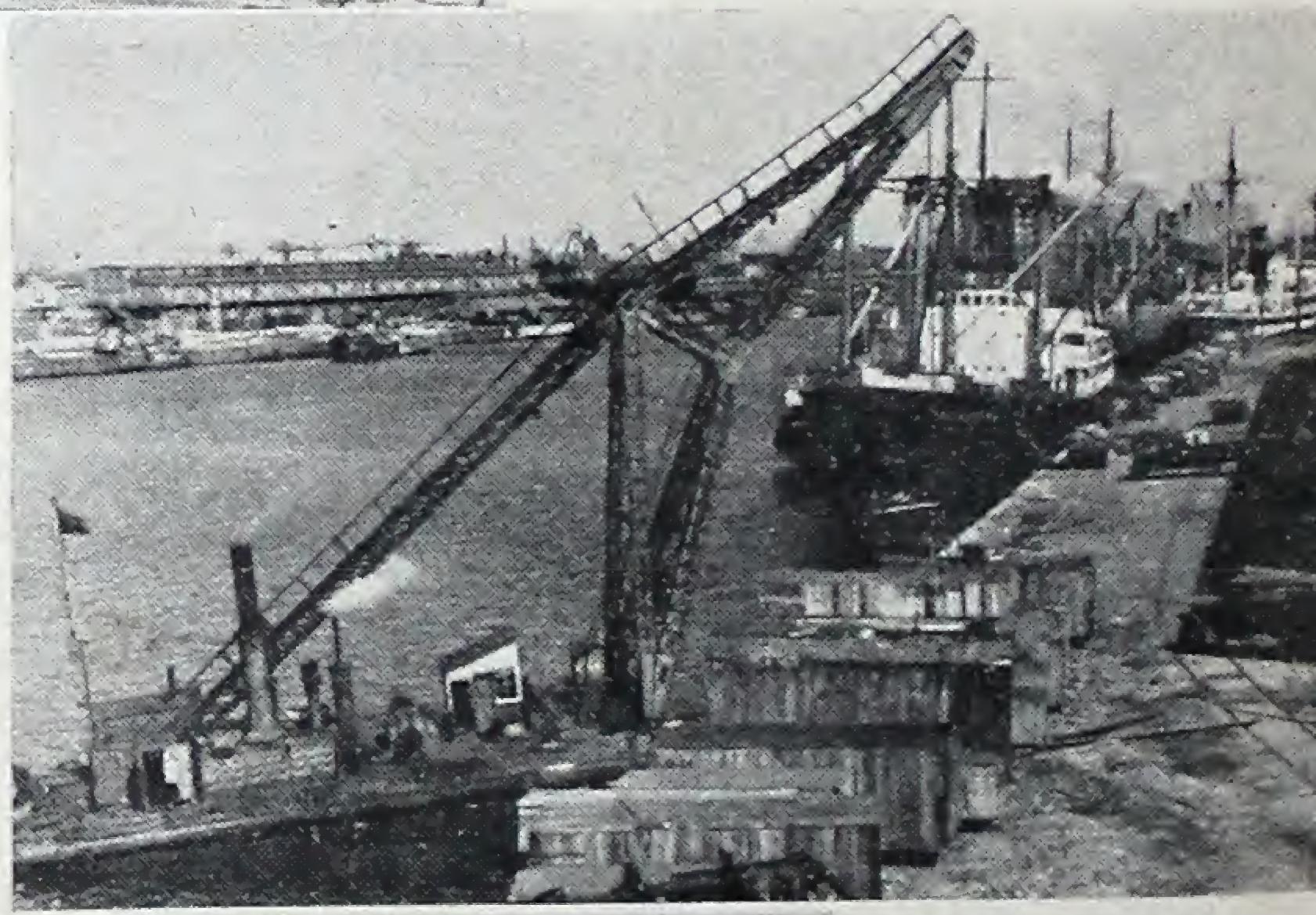
After the First World War and the civil war the young Soviet Republic was left with only 30 per cent. of its seagoing tonnage and most of the surviving ships were in a very bad state of repair. By 1922 Soviet seamen had re-equipped their vessels sufficiently to begin regular cruises.

By 1925 the first ship-building programme was adopted and from then on, throughout the whole period of the three prewar Five-Year Plans the development of Soviet shipbuilding continued. Many excellent vessels came off the stocks in these years—the "Krymchak" series, working the Black Sea routes, the London line of motor vessels, tankers, timber vessels, self-loading vessels and schooners for the Azov Sea, and so on.

While shipbuilding progressed the Soviet seaports were enlarged and improved, too. Machinery was introduced on a large scale and ferro-concrete buildings, quays and embankments were constructed. Specialised ports were built in various districts—the timber port at Leningrad, the oil wharves at Tuapse, the ore loading wharves at Azovstal and Kamyshburun, the timber quays at Murmansk and Novorossisk and the elevators at Kherson and Mariupol.

By the outbreak of the Second World War the Soviet

The S.S. "SESTRORETSK" from Leningrad, unloading goods at the Surrey Commercial Docks, London. She carries passengers also.



Loading the steamer KAZAKHSTAN. The quaysides at Leningrad are busy once again.

Vladivostok. From here passenger boats, merchant ships, tankers and motor vessels put out to the U.S.A., Kamchatka, China, S. America and the Far North. In the foreground is the KAMENETS-PODOLSK which will take fishermen and hunters to S. Sakhalin.

merchant fleet had been enlarged to six times that inherited from old Russia.

During the war the merchant vessels were used by the Red Navy for landing operations. They also worked behind the enemy's lines, forced the minefields and blockade, transported munitions, food and equipment, and frequently engaged in duels with the enemy, shooting down aircraft and sinking enemy vessels.

Soviet merchantmen also sailed from the Far East to America and from the northern ports to America and Great Britain, as individuals and as part of Soviet or Allied convoys. A considerable part of our foreign trade was carried by Soviet vessels during the war. Many sailors of Soviet crews travelling in allied convoys earned British war medals.

The seaports played an important part in the war. They had to handle large contingents of troops and equipment and also the incoming goods traffic from the Allies. Ports like Murmansk, Odessa and Novorossisk worked under almost continuous air raids, but despite this, vessels were loaded and unloaded the whole time. The work of Soviet dockers in wartime has been praised by the United States Military Mission.

During the war new ports were built and are now being completed at Molotovsk and Petropavlovsk-on-Kamchatka, at Vanino and Nakhodka. The ports of Murmansk, Vladivostok, Archangelsk, Krasnovodsk and Baku were greatly extended. They were fitted out with new machinery, electric cranes, stacking machines and internal port transport.

FUTURE PROSPECTS

The Five-Year Plan for rehabilitation and development, together with the rapidly developing foreign trade of the U.S.S.R. provide the merchant fleet (and the harbours, shipyards, and port installations under the jurisdiction of the Ministry) with some big tasks. By 1950 sea-borne freights will be more than double those of prewar days. New vessels totalling 600,000 tons will be built for this purpose.

Several new types of ship have been designed, both

for coastal and ocean voyages. A number of 12,000-ton liners with a speed of 27 knots will be launched by 1950, designed for service between the U.S.S.R. and America, Australia, India and Africa. For passenger lines in the Black Sea and Baltic, vessels of 5,500 and 6,000 tons will be launched. Big, high-speed "water-gliders" will be built for short cruises of 100 and 200 miles.

Soviet seaports, especially those in the south and in the Baltic were completely ruined by enemy action. The Five-Year Plan, therefore, makes provision for the rebuilding of the Baltic, Azov and Black Sea ports and for the completion of the new Far Eastern ports. The freight-handling capacity of the ports will be increased by the mechanisation of all loading and unloading and of all stacking in the port warehouses. The number of deep-water quays to take modern steamers will be increased by 70 per cent, as compared with 1940; this will be sufficient for all deep-sea vessels to put in at Soviet ports.

The capacity of repair and graving docks in 1950 will be two and a half times as great as in 1940 while three new repair yards are to be built. Floating docks, slips and similar installations for raising ships will be increased by 80 per cent.

Two new shipyards will be built during the next five years, one on the Black Sea for the construction of sea-going vessels and one on the Baltic for the construction of off-shore craft and tugs.

Another feature of the plan is the development of the Northern Sea Route so that by 1950 it will be a regularly functioning sea lane.

The Northern Sea Route, developed during the last 15 years, has opened many formerly untouched regions for economic development. Larger cargoes are being carried every year and the time taken for the through trip is being gradually reduced. There are already a number of permanent communities along the route with meteorological stations, radio installations, lighthouses, etc., which make navigation possible.

In Yakutia, in the settlements at the mouth of the Kolyma and at many other points which were formerly

served only by animal transport in winter and river transport during the short summer, supplies now come by sea.

A Sakhalin Shipping Trust has been set up, incorporating the former Nikolayevsk-on-Amur shipping Trust, which for several years serviced Northern Sakhalin, the Maritime Territory and the coast of the Sea of Okhotsk. Formerly, the Kurile Islands barred the exit of Soviet ships into the ocean and limited the country's communications with vitally important regions in the North. Vessels could sail only 120 days in the year.

The new Sakhalin Shipping Trust will have several new ports, of which Maoka is the largest.

The sailors on the Northern Sea Route are the descendants of the old seafarers and whalers who settled on the northern shores hundreds of years ago. The history of the many voyages of exploration made by these bold spirits shows that a fine body of deep-water sailors has grown up in Russia.

The U.S.S.R. is training seamen for a further increase in merchant shipping. The Five-Year Plan, when fulfilled, will pave the way to the fullest utilisation of the Soviet Union's geographical position as an important sea power.

IV. INLAND WATER TRANSPORT

by GEORGI KUBLITSKY

THE IMPORTANCE OF WATERWAYS TO RUSSIA

THE development of the Russian state is closely connected with the waterways: the first settlements were built on lakes and rivers, the boundaries of the state extended along the rivers, and the rivers leading to the seas were the great trade routes of the past. The route from the Baltic to the Black Sea, "from the Sea of the Varangians to the Sea of the Greeks," followed the Neva, Volkhov, Lovat and Dnieper.

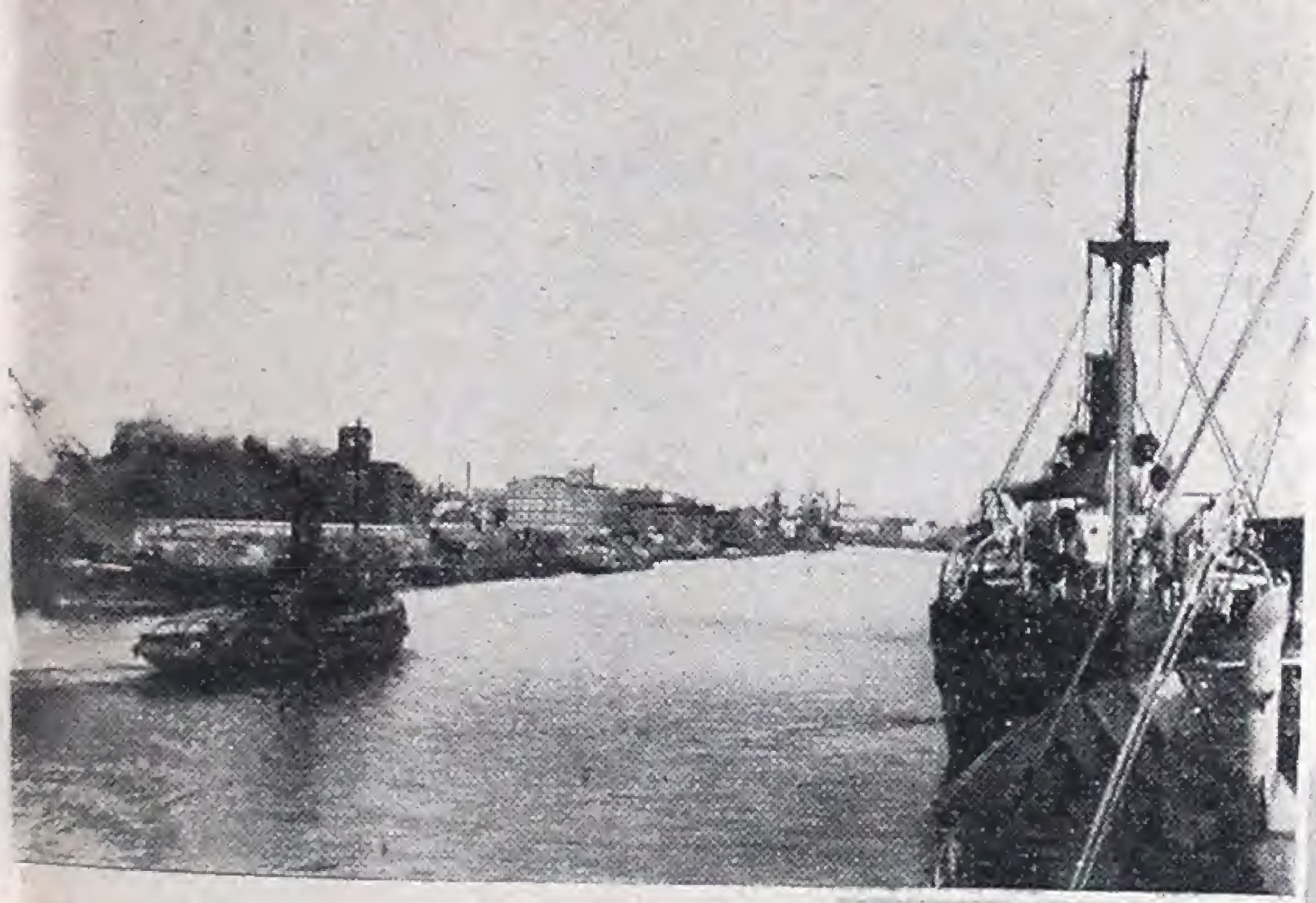
Later when the state of Muscovy between the Oka and the Volga became the centre of Russian civilisation, the latter river became the most important trade route. Strings of big boats, as many as 500 or 600, sailed down the Volga and across the Caspian to trade in Persia.

The appearance of Chancellor's vessels in the mouth of the Northern Dvina and the granting of special privileges to the British by Ivan the Terrible led to a busy trade on the northern rivers which became the chief routes for foreign trade.

A further impetus to the development of the inland waterways was given by Peter the Great who built a system of canals, connecting the Volga with St. Petersburg and the Baltic.

The first steamer that sailed up the Neva in 1815 between huge crowds that lined the embankments was built by a Scotsman, Charles Baird. Two years later a Russian shipbuilder Vsevolozhsky used his drawings to build two steamers on the Kama.

Inland water transport developed throughout the 19th century. In 1890 a Perm gun foundry built a super-tug that could pull 40 small barges. Barges made of metal were built on the Volga according to the old type of streamlined wooden vessel known as "Rosshiv." These barges could



Post-war shipping has increased in the canal of the Latvian seaport of Liepaja (Libau).

A motor passenger vessel returns to Khimki Port, a few miles out of Moscow, after an excursion along the Moscow-Volga Canal.

River craft on the Volga near the town of Gorky.

carry over 10,000 tons, as much as a modern Liberty ship.

When the Diesel engine made its appearance Russian engineers at the Sormovo Works on the Volga built the world's first Diesel tug.

During the civil war, when the white armies retreated, they destroyed all the ships and barges on the rivers. Kolchak, for example, burnt the Kama fleet.

By the 1919 navigation season only one fifth of the ships and a third of the barges belonging to the Volga fleet were fit for use. In 1918 the freight carried on the rivers was 16 per cent. of that of 1913. The Soviet government, therefore, had a big task in re-establishing the inland water fleet, but by 1929 the river fleet was working at a level above that of 1913, as the following figures show:

	1913	1929
Freight carried in millions of tons	48	50
Passengers carried in millions ...	11	23

This was the first step towards developing inland water transport in the Soviet Union and was the result of the planned utilisation of all resources. There are 108,000 rivers in the U.S.S.R. and her navigable inland waterways, lakes and rivers, amount to 520,000 kilometres (325,000 miles). In 1913 only 45,000 kilometres of these waterways in the European part of Russia were used by shipping while in the whole of Siberia there were only 420 steamers.

NEW CANALS AND RECONSTRUCTION OF WATERWAYS

Here are a few facts concerning what has been done since.

The building of dams for power stations on the Volkhov and Svir raised the level of these rivers and made them suitable for bigger ships. Since time immemorial the Dnieper has been divided into two parts by the gigantic rapids at Zaporozhie. The dam for the Dnieper Power Station raised the level of the water to such an extent that the rapids disappeared and the river became navigable for big vessels from the upper reaches to the Black Sea. The

Dnieper thus became the third most important river in Europe (bigger rivers are the Volga and the Danube).

In 1933 the White-Sea-Baltic Canal was built to connect the two seas by an inland waterway. This canal brought the timber of the north to the Baltic, brought freights from the White Sea to Leningrad and on to the Volga.

In 1937 the Moscow-Volga Canal was completed. The canal is 128 kilometres long; its building entailed the removal of 200 million cubic metres of earth and rock and the laying of 3,000,000 cubic metres of concrete. The installations on the canal include 11 locks, 11 dams, 8 power stations and 5 pumping stations. The huge reservoirs filled with water by the canal cover the sites of over 200 villages.

If we compare the Moscow-Volga and the Panama Canals we see that the volume of work on the Moscow-Volga is only 7 per cent. less than that of the Panama while the channel dug is twice as long. The Panama Canal was built in 30 years (with interruptions, it is true, and counting both the French and American jobs); the Moscow-Volga Canal was built in 4 years and 8 months.

The canal enables the big three-decker Volga steamers to sail right into Moscow. The distance between Moscow and the Volga port of Gorky has been shortened by 110 kilometres and the distance to Rybinsk by 1,100 kilometres. Refrigerator ships from Astrakhan now carry fish direct to Moscow from the Caspian.

One other important feature of the canal is its architectural treatment. The country's leading architects and sculptors were employed as consultants and executives. The locks are ornamented with towers, light marble and granite columns, splendid statues and bronze models of Columbus' ships. A hundred thousand trees and half a million ornamental bushes have been planted along the banks. Many Moscow people spend their Sundays on the canal.

The Moscow-Volga Canal gives us an idea of the way in which Soviet inland waterways are being handled; the combination of good architecture and technical progress will satsify the most exacting tastes.

Shortly before the war a canal was built connecting the

Dnieper with the Bug and the Vistula, that is, connecting the Baltic and the Black Seas.

The reconstruction of the waterways was not confined to changes in routes. Revolutionary changes were made in the port installations. The industrialisation of the country enabled the river men to fit out their ports with cranes, transporters and other modern machines to do the work of man. In the ten years, from 1930 to 1940, the number of machines used in the ports underwent an eight-fold increase and their capacity a twenty-fold increase.

At the same time new vessels of modern design were constantly being added to the river fleet. Soviet shipyards began to deliver tugs of the "Tsiolkovsky" type whose efficiency figure is one of the highest in the world. By 1941 the number of steamers and motor vessels on the inland waters was 2.2 times as great as in 1929 and the number of barges was 2.7 times as great.

Traffic on the Soviet rivers amounted to 74 million tons in 1941. The network of inland waterways in regular use was increased to 101,000 kilometres (63,125 miles) by the building of new canals and the further clearance of rivers. Inland waterways used for navigation in the U.S.A. amount to 47,000 kilometres, in France to 12,000, in Great Britain to 7,500 kilometres.

Freight traffic on the Soviet waterways also stands at the head of the world's list. A total of 36,000 million ton-kilometres was reached (pre-war Germany's total was 26,000 million ton-kilometres).

WARTIME TASKS

During the war years 1941-45, the chief waterways of the country were either in the combat area or were used as direct lines of communication for the front. The Germans reached the Dnieper in the second month of the war; in the autumn of 1941 they reached the Volga at Kalinin and in the autumn of 1942, when the Stalingrad battle was at its height, the basins of the Dnieper, Pripet, Desna, Don, Kuban and other rivers were in German hands. For a short

time the enemy was able to hold the Volga at Stalingrad under fire.

It would take volumes to describe the courage of Soviet watermen during the siege of Stalingrad, and; indeed, there are few cases in history where a town with a big river behind it has been defended for so long a time and so successfully.

At a time when the river was open to the enemy and the appearance of a vessel brought down shells and bombs, the watermen transported 67,000 men and over 130,000 tons of stores and mail across the river.

And then the siege of Leningrad.

In the cold, hungry winter of 1941-42, when contact was made by lorries across the ice of Lake Ladoga—the "road of life"—shipyards were built on the bare banks of the lake and by spring huge barges capable of crossing the lake were built. Ports with mechanised quays and extensive railway communications were built at a cost of 40,000,000 roubles. The first barges of grain for Leningrad fought their way through the ice crust. They made the return journey with famished children, old men and women.

In the course of the war the Soviet river fleet suffered heavy losses. The enemy sank or seized 4,280 passenger, freight or tug steamers and 4,029 barges. They destroyed 479 ports and landing stages including such first-class ports as Leningrad, Stalingrad and Kiev. To this list of losses we may add 89 shipyards, factories and other installations and the Dnieper-Bug Canal, the Manych Waterway, the Northern Donets Lock System and some of the installations on the White-Sea-Baltic and Moscow-Volga Canals. Lastly, the Germans destroyed or burnt 3,500 buildings occupied by offices, stores, garages, etc., belonging to the river fleet and over 2,000 buildings occupied by the clubs, hostels and libraries of the rivermen.

By the end of the war navigation had been reopened on all the rivers. The ports had been repaired and the chief shipyards were got going. It is interesting to note that the big shipyards at Kiev had reached their prewar output level by 1944 and one after another new motor vessels are leaving the stocks for service on the Dnieper.

Even during the war Soviet salvage crews raised 1,200 vessels from the beds of the rivers and put 940 of them into operation again. Today the army of rivermen numbers over 300,000.

For obvious reasons the full data concerning the Uglich and Rybinsk installations on the Volga were not published until after the war. The Uglich power station, dam and locks, began working in September, 1941. The first section of the Rybinsk Power Station began producing current at the time when the Germans were at their closest to Moscow. Work on these big engineering installations continued and in addition to this by the end of the war some 37,000 vessels and rafts passed through the locks of these installations.

These two power stations and dams on the upper reaches of the Volga are the first step towards deepening the Volga and the Caspian Sea. They have made the upper reaches of the great Russian river navigable to vessels that formerly only plied on the lower part of the stream.

NEW DEVELOPMENTS

The prospects of further development of inland water transport in the U.S.S.R. were outlined in the Five-Year Plan adopted recently by the Supreme Soviet of the U.S.S.R.

At the session of the Supreme Soviet which adopted the law on the Five-Year Plan, Zossim Shashkov, Minister of the River Fleet, described the chief stages in the development of the Soviet inland waterways.

He said that today (March, 1946), over half the repairable vessels raised from the beds of lakes and rivers had been put into operation. About half the war-wrecked installations belonging to the Ministry had already been repaired. By the middle of the summer of this year, the White-Sea-Baltic Canal will again be opened.

In the near future the prewar freight level will be reached and surpassed. By 1950 the inland water transport system will carry 38 per cent. more freight than before the war. To effect this the self-propelled vessels of the river fleet will be increased by 300,000 horse-power during the five years while towed craft to be added will carry about

3,000,000 tons. In the same period the fullest possible mechanisation will be effected so that all loading and unloading in the ports is 75 per cent. mechanised and manual labour reduced to a minimum.

The new power stations and dams to be built on the Kama will increase the importance of this river as a transport artery of the Urals. Two new hydro-electric power stations are to be built on the Volga and on the Oka. In the five years the Volga-Baltic Canal System will be reconstructed so that the big Volga vessels will be able to sail up to Leningrad and the White Sea.

River transport is all-important in Siberia and the Far East. In these vast territories there are few railways, and ships of the Irtysh, Yenisei, Lena, Amur and other Siberian and Far Eastern rivers will be carrying millions of tons of timber, hundreds of thousands of tons of grain, and great quantities of oil, salt and other cargoes.

River boats will also ply with their cargoes to the districts of the Far North beyond the Artic circle, supplying food and consumer goods to gold fields, saw mills and hunting and fishing villages on the shores of the Artic Ocean.

Long-term plans are as titanic in scope as the waterways of the U.S.S.R. are colossal. Increased freights will eventually require the deepening and complete reconstruction of the whole Volga-Baltic system. This is the "Greater Volga Scheme" which includes the construction of a number of power stations, the irrigation of the Volga steppes and the raising of the level of the Caspian. The scheme includes a canal joining the Volga and the Don and many other big features that will be put into effect in the not-too-distant future.

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